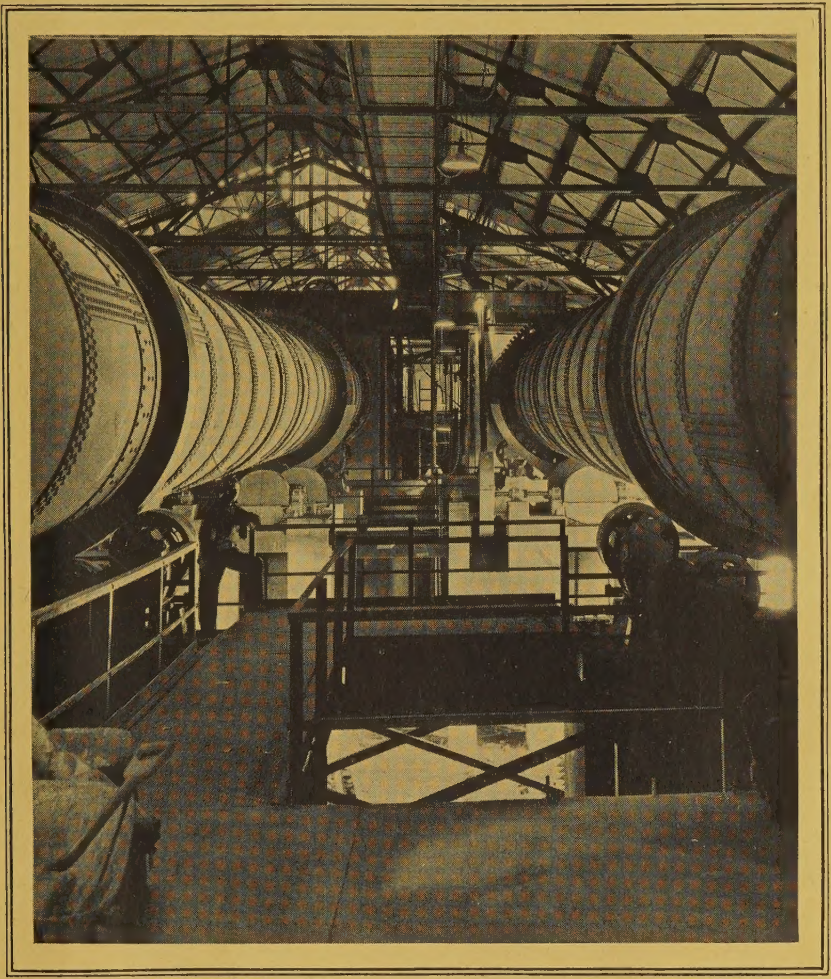
MILL SECTION of

Concrete



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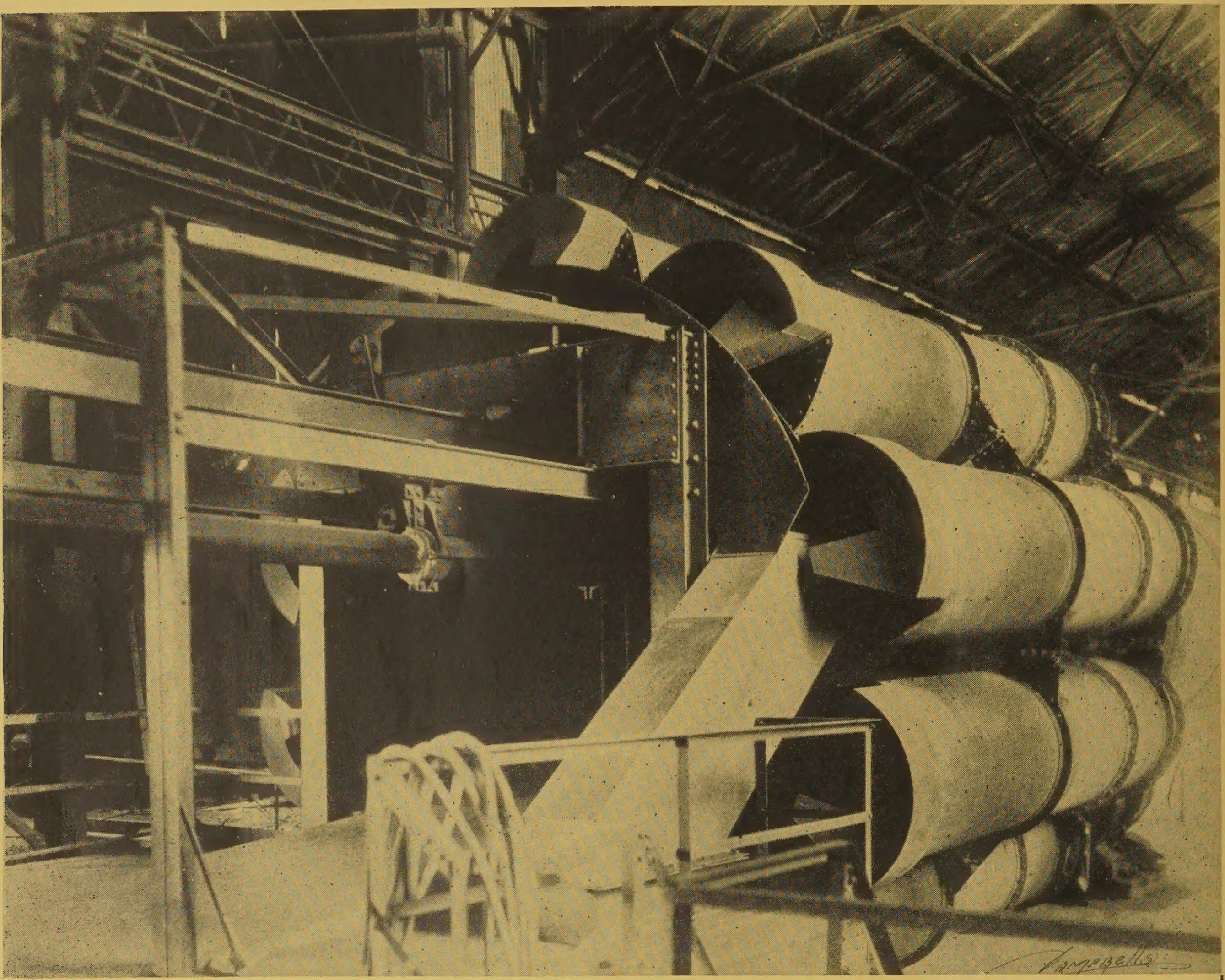
Index to Advertisers on Page 99 of This Section



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Index to Advertisers on Page 99 of This Section

MILL SECTION of

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The Cement Mill Edition also contains all the material published in the corresponding Regular Edition and so provides news of the uses and merchandising of the materials whose manufacture is discussed in the Mill Edition. The Regular Section furnishes mill operating officials and mill executives valuable points of contact with the users of the materials they produce.

Volume 35 September, 1929 Number 3

CONTENTS

Chemical, Microscopic and X-Ray Studies of Alite *(Illus.)* 101
Some new German researches on the constitution of portland cement clinker, reported by the Research Institute of the Association of German Iron-Portland Cement Manufacturers.

Cement Industry Continues to Fight for Tariff 105
American portland cement manufacturers outline reasons for demanding a protective tariff.

Merge Medusa and Newaygo Companies 108

Spanish Cement Plant Located Adjacent to Rich Raw Materials *(Illus.)* 109
A continuation of the description of the Villaluenga plant of the Asland Company.

Cement Reference Laboratory Begins Work of Inspection 112

Editorial 113
Brand Names.
Public Relations.
The Chemist.

Calcium Sulphate Retarders for Portland Cement Clinker 114

1928 Cement Production Tops All Records 115
Final figures on 1928 productions and shipments.

Men and Mills *(Illus.)* 119

Cement Statistics for July *(Illus.)* 120

With the Manufacturers 122

In the Construction Section

~

A Tariff on Cement 25
An editorial urging cement users to consider the economic and not the political angle of the question.

Building the Detroit-Canada Tunnel 13

Tile and Joist Concrete Floors 21

Concrete Rock Bear Dens 27

Concrete Manhole Slabs 31

Selling Construction Service 45

Modern Stucco and Plaster 49

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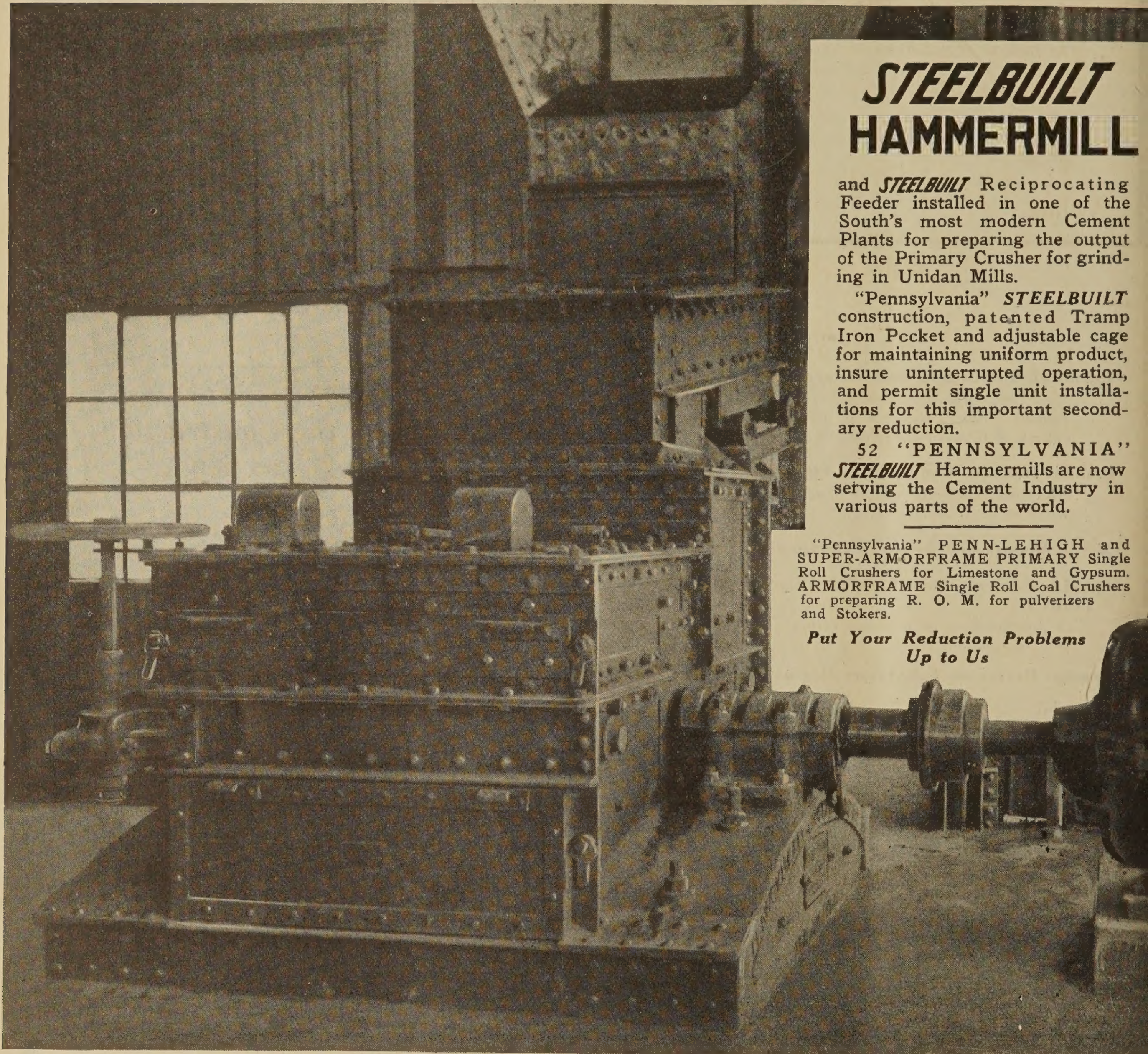
INDEX TO ADVERTISEMENTS

Allis-Chalmers Mfg. Co. 133
Babcock & Wilcox Co. 129
Bradley Pulverizer Co. 137
Burrell Engineering & Const. Co. 134
Combustion Engineering Corp. 121
Du Pont de Nemours & Co., Inc., E. I. 127-128
Edge Moor Iron Co. 131
Engineering & Designing 94
Foster Wheeler Corp. 136
Fuller Co., The 130
Fuller Lehigh Co. 132
Goodyear Tire & Rubber Co., The 135
Haynes Stellite Co. 123
Hunt, Robert W., Co. 94
Jones Foundry & Machine Co., W. A. 124
Kritzer Co., The 94
Link-Belt Co. 125-138
Manitowoc Engineering Works 97
Meade, Richard K., & Co. 94
Northern Blower Co. 137
Pennsylvania Crusher Co. 100
Schaffer Poidometer Co. 136
Smidth, F. L., Co. 98
Super Cement Co., The 96
Texas Co., The 128
Timken Roller Bearing Co., The .... Front Cover



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Index to Advertisers on Page 99 of This Section

MILL SECTION of

Concrete

Vol. 35 Chicago, September, 1929 No. 3

Chemical, Microscopic and X-Ray Studies of Alite

Report of the Research Institute of the Association of German Iron-Portland Cement Manufacturers, Dusseldorf, as Published in Zement

By DR. A. GUTTMANN and DR. F. GILLE

THE interpretation of the nature of alite has not become any clearer in the course of the past year; on the contrary, it has become more and more confused. We can recognize two distinct groups. American scientists[1] take alite to be tricalcium-silicate; German scientists regard it as a mixed crystal or a mixture of different compounds. Dyckerhoff[2] calls it a dicalcium-silicate with possible excess lime. Nacken[3] states, that dicalcium-silicate is the prerequisite for the formation of alite, yet leaves the nature of the mixed crystal unanswered. Jänecke[4] maintains that it is a mixture of the product of his discovery—"Jäneckeit"—with bicalcium-silicate and denies the possible existence of tricalcium-silicate. Kühl[5] finds it to be a mixed crystal of tricalcium-silicate and Jäneckeit or—which amounts to the same thing—of tricalcium-silicate and a hypothetical bicalcium-aluminate. He believes in the occurrence of pure tricalcium-silicate in the clinker. The authors of this paper have generally assumed it to be tricalcium-silicate, though the alumina content of the alite samples analyzed in the course of their investigation made them assume also a formation of mixed crystals with tricalcium-aluminate.

Isolate Pure Crystals

As this difference of opinion is due mainly to the lack of unquestionably accurate alite analyses, the authors undertook, as their first task, the isolation of the pure crystals from commercial clinkers. An isolation of this kind[6] presents considerable difficulty and is a laborious process. However, it has the advantage that results obtained from such samples have a practical significance, while those observed on synthetic samples often lead to erroneous conclusions.

To eliminate accidental errors, the alite was isolated from two clinkers, whose composition was chosen to be as widely different as possible. The chemical analyses of the clinker[7] are as follows:

TABLE 1.

	Clinker G Oct. 22, 1927	Clinker O March 20, 1928
SiO_2	17.62	22.7
Al_2O_3	6.63	5.4
Fe_2O_3	2.22	3.1
Mn_2O_3	2.61	0.1
CaO	65.82	67.4
MgO	3.17	1.2
SO_3	1.79	0.1

These two clinkers were selected mainly for the following reasons:

Alite Crystals in Thin Sections

Thin sections of both clinkers (Figs. 1 and 2) showed a good formation of alite crystals, one (G) showing also celite and glass, the other (O) belite in addition to these. The chemical composition of these clinkers was also worthy of note—one (O) containing no free lime, as established by a thorough test in accordance with White's[8] method; the other being high in lime and yielding a noticeable-to-strong lime reaction. The latter clinker also contained an unusually high amount of manganese (2.6 Mn_2O_3) in comparison to a standard portland cement clinker.

The isolation of alite was accomplished by separating the fines passing the 10,000-mesh sieve by means of liquids of high specific gravity (methylene iodide and acetylene-tetrabromide mixtures) in a centrifuge. This process has been previously described by the authors.[8] The check tests of purity of the samples were made under the microscope (also by means of coloring). The most favorable density of the elutriating medium, which would yield alite as free as possible of the heavy celite, yet would retain the relatively light aluminate, was determined for clinker (G) as 3.06 to 3.11 and for clinker (O) as 3.10 to 3.15. The specific gravity of alite is, however, higher, as shown by the separation of thoroughly dried samples. Its density was obtained as 3.2 in both cases.

---

[1] P. H. Bates, CONCRETE-CEMENT AGE, 2, 1, 1913. P. H. Bates and A. A. Klein, Tech. Papers of the Bureau of Standards, No. 78, 1917. A. A. Klein and A. J. Phillips, Tech. Papers of the Bur. of Standards, No. 43, 1914. G. A. Rankin, *Journ. Ind. Eng. Chem.* 7, 1915, 466.

[2] W. Dyckerhoff, Diss. phil. Frankfurt a. M. 1925, *Zement* 1927, p. 735.

[3] Report of the 51st Convention of the Assn. of German Ptld. Cem. Mfrs. 1928, p. 42.

[4] Ditto, p. 8.

[5] Ditto, p. 38.

[6] Corresponding tests by LeChatelier, Tornebohm and Unger—without use of the centrifuge—gave no satisfactory results.

[7] *Zement*, 1929, Nos. 16-18. "Manganese in Cement Clinker; a Contribution to the Study of the Constitution of Cement." Both were high test clinkers. Their technical properties will be found in Tables 3 and 8, as No. 4 in the above ref.

[8] *Journ. Ind. Eng. Chem.* 1, 5, 1909.

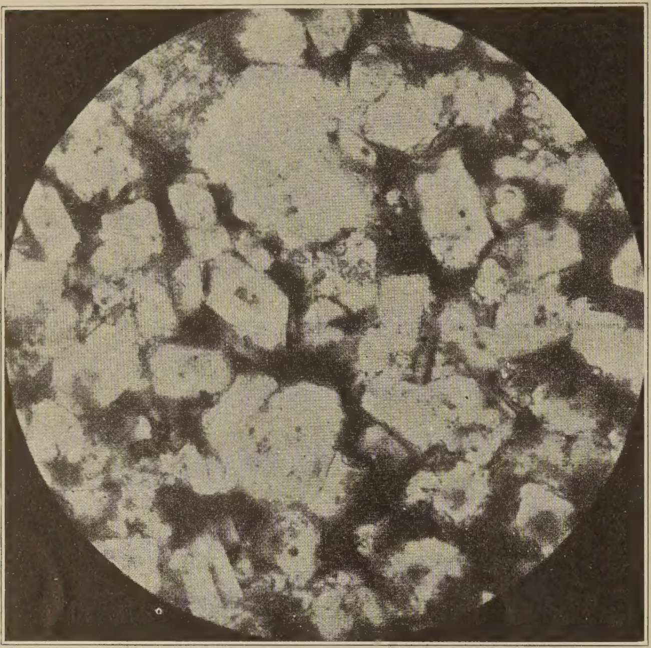

Figure 1

Figs. 3 and 4 show the isolated alite, magnified to the same degree as the clinker sections (Figs. 1 and 2).

Chemical Tests

Table 2 gives the clinker analyses as well as the analyses of alite obtained from them. The latter are placed side by side to show the great similarity of the two cases.

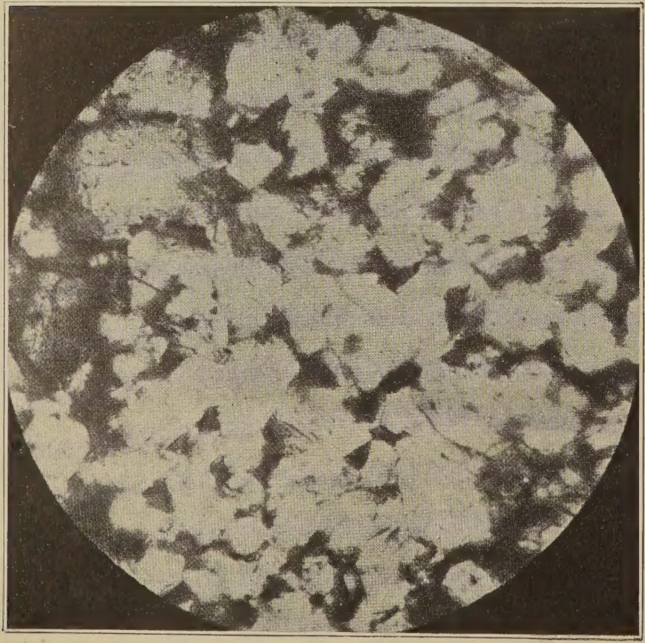

Figure 2

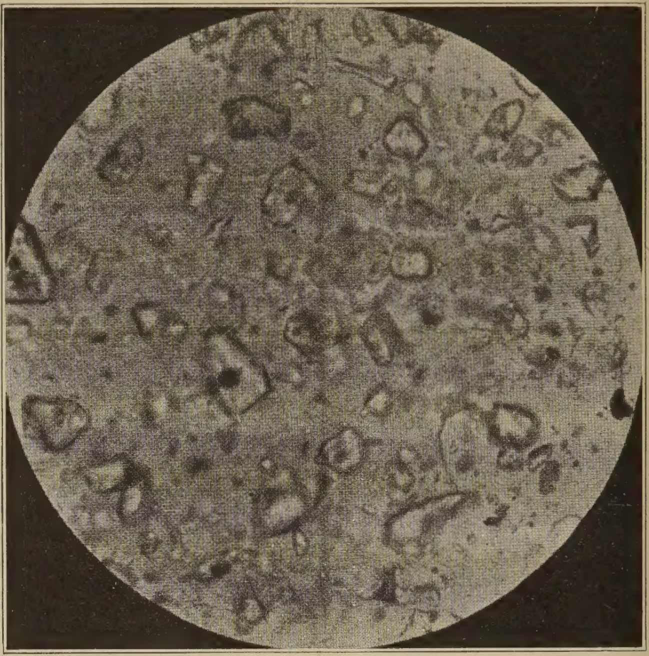

Figure 3

TABLE 2

	Clinker G	Alite fraction		Clinker O
	Oct. 22-'27	Clinker G	Clinker O	Mar. 20-'28
SiO_2	17.62	22.70	24.51	22.7
TiO_2	not det.	0.30	0.10	not det.
Al_2O_3	6.63	3.50	2.06	5.4
Fe_2O_3	2.22	0.55	1.23	3.1
Mn_2O_3	2.61	0.71	0.10	0.1
CaO	65.82	69.87	70.84	67.4
MgO	3.17	1.64	0.92	1.2
Na_2O	not det.	0.56	0.25	not det.
SO_3	1.79	------	------	0.1

One notes that the alite fractions consist mainly of silica and lime with small quantities of alumina. Com-

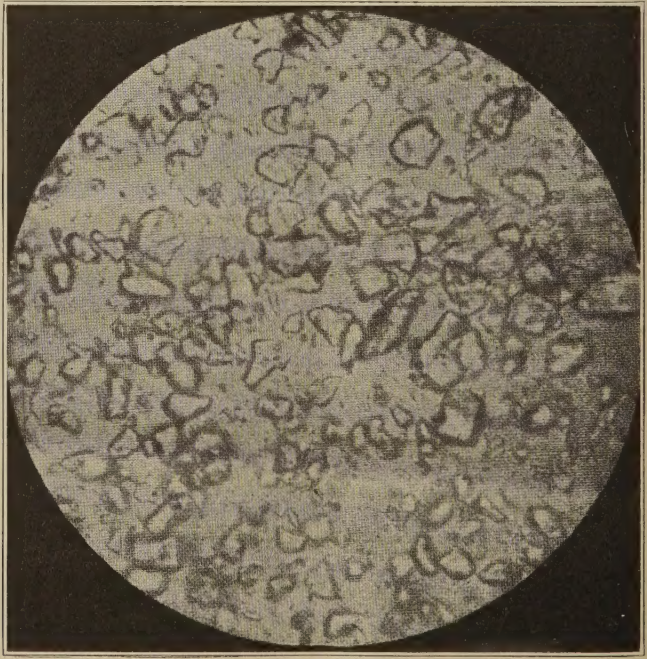

Figure 4

pared to the clinkers, the following is observed:

1. The silica content is higher in both cases; the silica content of the alite from high-silica clinker has increased less than that of the alite from low-silica clinker.

2. The lime content is higher in both cases; it shows a greater increase in the case of the low-lime clinker than in that of the high-lime clinker.

3. The alumina content is lower; in the case of the low-alumina clinker it has dropped to less than one-half; in that of the high-alumina to a little over one-half.

4. The content of the other sesuioxides has dropped to about one-third to one-quarter of that of the clinker.

5. The magnesia content is also lower.

As stated before,[9] a microscopic investigation of clinker fractions separated in a centrifuge reveals—in spite of careful separation—small quantities of foreign constituents, which in this case are made up especially of celite. As shown at a previous occasion, celite contains iron and manganese as well as a great part of the alumina and magnesia—the latter at least in part—in the form of lime compounds. Therefore, to obtain a clear idea of the composition of alite, the celite was eliminated from both analyses in accordance with the formulas, for:

Clinker G. $1.2MgO \;.\; 4.6CaO \;.\; 1.6\, Al_2O_3 \;.\; 1(Fe,Mn)_2O_3$.

Clinker O. $0.6\, MgO \;.\; 4.6CaO \;.\; 1.6\, Al_2O_3 \;.\; 1(Fe,Mn)_2O_3$.

The former formula was derived from Table 7 of the reference on manganese in cement clinker,[10] taking account of the magnesia content (compare Table 5 of same reference). The second formula is analogous to the first and was derived by taking into account the magnesia content in accordance with Tables 1 and 2 of the above reference.

Upon eliminating the celite, one obtains a molecular ratio

$$\begin{array}{lcc} & \text{Alite of} & \text{Alite of} \\ & \text{Clinker G} & \text{Clinker O} \\ \dfrac{CaO + MgO + Na_2O}{SiO_2 + Al_2O_3 + TiO_2} = & \dfrac{3.11}{1} & \dfrac{2.99}{1} \end{array}$$

The same computation applied to the clinkers gives: a ratio for:

$$\text{Clinker G} \ldots\ldots \frac{3.31}{1}$$

$$\text{Clinker O} \ldots\ldots \frac{2.83}{1}$$

The value of the quotient has decreased in alite from Clinker G compared to the clinker itself, while the opposite is true of alite from clinker O. In both cases alite tends to approach the ratio of 3:1.

The insignificance of all other constituents in comparison to the two main constituents—lime and silica—is best demonstrated by the following table of molecular ratios for the alite analyses:

	CaO :	MgO :	Al_2O_3 :	SiO_2
Alite G	3.19	0.03	0.05	1
Alite O	3.00	0.04	0.02	1

From the foregoing it is clear that tricalcium-silicate $\left(\dfrac{3CaO}{1SiO_2}\right)$ is the main constituent of alite.

The rational composition of the two clinkers and of their alite fractions can now be represented as follows:

TABLE 3

Computed Analyses of Clinkers and Their Alite Fractions in Per Cent

		Alite Fraction of		Clin. O
	Clink. G	Clink. G	Clink. O	
Tricalcium-silicate $3(Ca,Mg,Na_2)O \;.\; (Si,Ti)O_2$	66.9	86.7	93.1	70.5
Celite	19.1	5.4	5.0	12.1
Tricalcium-aluminate	—	—	—	—
$3CaO.Al_2O_3$	4.4	5.5*)	1.9	5.7
Free lime CaO	5.4	2.4	---	---
Beta-Bicalcium-silicate $2CaO \;.\; SiO_2$	---	---	---	11.9

In the above table the slight quantity of alumina (0.7 and 2.1 per cent respectively) remaining upon elimination of celite was assumed to be in the form of tricalcium-aluminate; for, as will be shown later, this remainder must be present mainly as free aluminate, i. e., tricalcium-aluminate, since bicalcium-aluminate is unstable as such. Whether there is a possibility of mixed crystal formation between the bi- and tricalcium-aluminate on one side and tricalcium-silicate on the other, is but of pure scientific interest, for the analysis shows the simultaneous existence in the clinker of tricalcium-silicate and tricalcium-aluminate.

Microscopic Studies

Both alite fractions revealed in the main the same optic properties, as determined previously[11] on pulverized samples and thin sections. The alite crystals were present as hexagonal plates or as thick prisms with pronounced cleavage perpendicular to the axis. The refraction exponent for a_{Na} was ∞ 1.718 ± 0.002 and for δ_{Na} ∞ 1.722 ± 0.002. The optic character was negative; the angle between the axes was small; double refraction was ∞ 0.005. In the presence of a pronounced longitudinal direction of the crystals y' lay in that direction.

Microscopic investigation revealed celite as a secondary constituent.

Coloring with Patentblau (Patent blue) in 0.1 per cent solution yielded small quantities of a substance rapidly assuming the color, which was taken to be aluminate. This substance was more marked in alite G than in alite O (compare Table 3). Exact determinations will be made when this substance is isolated. Alite did not become colored for some time and took on only a slight coloring. In agreement with the chemical data, which yielded for the main clinker constituent a ratio of bases to acids of 3:1, microscopic investigations permit the conclusion that this ratio is characteristic for alite, i. e., that alite is made up mainly of tricalcium-silicate. The very slight alumina content (2 to 3.5 per cent) of the alite analysis (Table 2) can only be present in alite itself to a negligible extent in accordance with the coloring tests. It is to be attributed mostly to the foreign constituents—celite and aluminate.

X-Ray Studies

X-ray studies of both alite fractions confirmed the conclusion that in alite we deal mainly with tricalcium-silicate. Debye-Scherrer pictures were made at the Kaiser-Wilhelm-Institute for Research in Iron, Düsseldorf.[12] A camera of 27 mm. radius was used. The pictures were taken with copper rays of a commercial X-ray tube.[13] The samples were made up into rods, rolled in cigarette paper and exposed to the rays. The duration of exposure was considerably shorter than that used by Harrington operating with molybdenum rays.[14] To obtain a comparison with pictures taken by Brownmiller[15] of tricalcium- and dicalcium-silicate, special precision exposures were taken, using an admixture of 30 per cent NaCl. The distance *a* of this salt was assumed to be 5.626 A°. The following time of exposure was selected for the X-rays:[16]

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[9] See footnote 8.

[10] See footnote 8.

*The increase in aluminates in alite fractions was produced by a compromise in the specific gravity of the elutriating liquid. Had its density been selected higher, the aluminate content would have been reduced, yet celite would have increased.

[11] *Tonindustrie-Zeitung*, 1928, No. 22.

[12] The authors are taking this opportunity to thank the Director of the Institute, Dr. Korber, and particularly Dr. Wever, for their co-operation.

TABLE 4

Sample	Ordinary X-ray	Precision X-ray
Alite fraction of Clinker G	13 hr.	13 hr.
Alite fraction of Clinker O	5 hr.	10 hr.

Alite fraction O was the first one to be investigated.

It was found that 5 hours sufficed to produce a satisfactory X-ray. The most favorable duration of exposure, however, for the arrangement at hand lay closer to 15 hours. The radiating energy in all tests was 20 MA and 37 KV max.

In comparing the results with those obtained by Hansen and Brownmiller on tricalcium-silicate and dicalcium-silicate, the following should be noted concerning the occurrence of the former compound:

W. C. Hansen[17] produced his tricalcium-silicate by three different methods—always without addition of alumina—and had the samples investigated by means of X-rays by Brownmiller. An agreement was found in all cases. The alumina content of the samples was 0.2 per cent. This ought to be sufficient to disprove Jänecke's contention that the compound does not exist.[18]

Figs. 5 and 6 reproduce the X-rays of the two alite fractions. The measurements are tabulated in Table 5. For the sake of comparison the table also shows values for tri- and bicalcium-silicate obtained by Hansen and Brownmiller. The factor used in comparing the values was:

$$d = \frac{\lambda \, . \, \mathrm{Cu}\alpha}{2 \sin \vartheta}$$

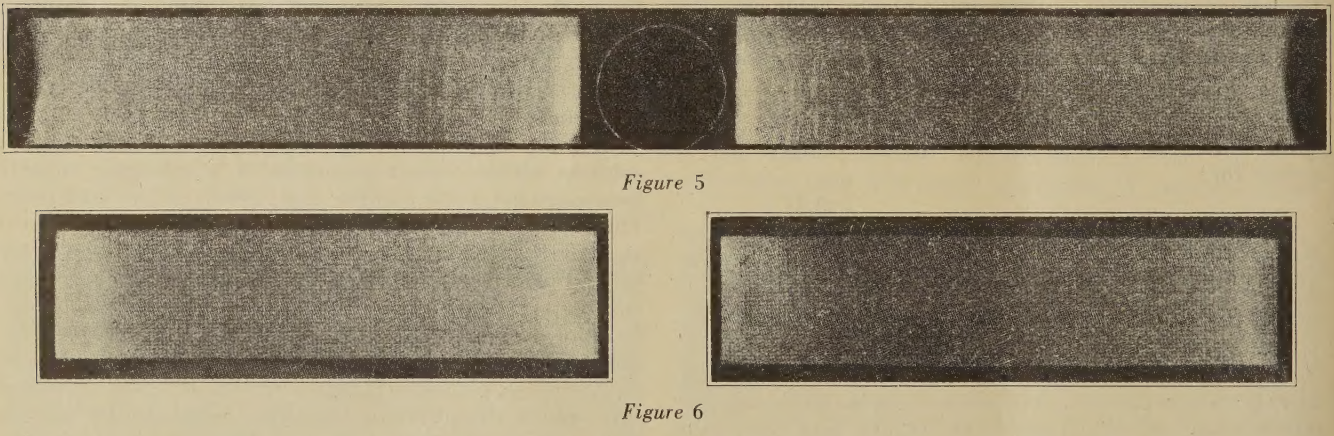

Figure 5

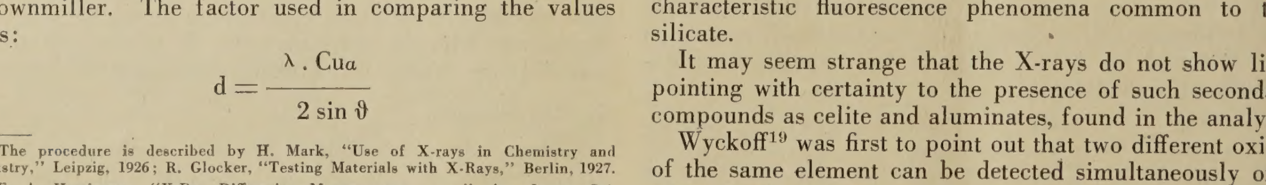

Figure 6

As seen from Table 5, the values of the two alite fractions show a good agreement. Also, in comparing the corresponding values for tricalcium-silicate, one finds that —with the exception of one weak line between alite lines 24 and 25, all of the lines indicated by Brownmiller are present in these alites, agreeing in numerical values as well as in strength. Both alites have a few more lines, particularly in the vicinity of the primary ray. They were rather weak and could be found only when the darkness around the primary ray was not too intense.

A comparison with the values of dicalcium-silicate shows that the lines do not correspond either in intensity or in the numerical values. Though some of the lines of bicalcium-silicate coincide with those of tricalcium-silicate or are very close, a study of the entire evidence of lines and of their intensity reveals such marked differences, that there can be no doubt that alite is not identical with bicalcium-silicate on the basis of the data furnished by X-ray studies.

Conclusions from X-Ray Studies

The following conclusions can be drawn from the X-rays concerning the occurrence of dicalcium-silicate: lines No. 5 and 15 of the alite fractions can not be produced by concentrations of beta-bicalcium-silicate; were this the case, the more intensive lines of this silicate with d = 1.975 and 1.895 should also make their appearance, which is not the case. The same applies to lines 1, 2, 3 and 5 in the X-ray of gamma-dicalcium-silicate which has about the same numerical values (due to lack of space these values are not reproduced here). All four lines are weak lines of gamma-bicalcium-silicate. Should it be present, its strong characteristic line with d = 1.905 would also appear. This, however, is not the case. Neither did observations of the sample in ultra-violet light reveal the characteristic fluorescence phenomena common to this silicate.

It may seem strange that the X-rays do not show lines pointing with certainty to the presence of such secondary compounds as celite and aluminates, found in the analysis.

Wyckoff[19] was first to point out that two different oxides of the same element can be detected simultaneously only when the lesser amount is greater than or equal to 10 per cent. Hansen[20] has investigated further to what extent the compound pentacalcium-trialuminate can be detected in a cement mix by means of X-rays. He found that this limit lies in the neighborhood of 7 per cent. For free lime, this limit becomes 3 per cent. The X-rays of the

(Continued on Page 117)

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[13] The procedure is described by H. Mark, "Use of X-rays in Chemistry and industry," Leipzig, 1926; R. Glocker, "Testing Materials with X-Rays," Berlin, 1927.

[14] E. A. Harrington, "X-Ray Diffraction Measurements, etc.," *Am. Journ. Sci.* V, Vol. XIII, No. 78, 1927.

[15] L. T. Brownmiller in: W. C. Hansen: "Further Studies on Portland Cement Compounds by the X-Ray Diffraction Method," *Journ. Am. Cer. Soc.*, Vol. 11, 1928.

[16] The duration of exposure differs in accordance with the apparatus and arrangement of test used.

[17] See footnote 14.

[18] In Hansen's original paper, as well as in an abstract of it in *Tonindustrie-Zeitung*, 1928, No. 15, the optic character of tricalcium-silicate is erroneously designated as positive. This is no doubt a slip, for, had Hansen actually discovered tricalcium-silicate to be optically positive; he would have pointed out the contradiction of Wright's earlier data, to which he himself makes reference in a paper by him with Ashton, Bogue and Dyckerhoff as joint authors (*Journ. of Phys. Chemistry*, Vol. 31, No. 4, 1927, p. 607, New York; *Zement*, 1927, p. 51).

[19] The structure of crystals, 1924, p. 419, New York.

[20] See footnote 14.

Cement Industry Continues to Fight for Tariff

Statement Presented Before Senate Finance Committee Outlines Situation—Widely Published Article Explains How Farmers Will Benefit from the Cement Tariff

A STATEMENT pointing out, among other subjects, the effect of tariff duty on cement prices and competition in the cement industry, was presented under the signatures of thirteen representative manufacturers before the Finance Committee of the Senate on June 19th.

Another effort in the same direction is the national publication given an article signed by C. B. Condon, vice-president of the Hawkeye Portland Cement Company, Des Moines, Iowa. The object of the article is to spike the suggestion that tariff will raise cement prices.

The statement presented before the Senate read, in part, as follows:

American manufacturers of portland cement, representing approximately ninety-four independent companies with 157 active plants in 32 states, ask that an adequate tariff duty be placed on portland cement, which has been on the free list since 1913.

Supporting data for this request was presented before the Ways and Means Committee of the House of Representatives prior to the framing of the bill under discussion. These data comprised a thorough study of the American cement industry and its principal foreign competitor, the Belgium industry. It was checked up and confirmed by experts of the United States Tariff Commission and is now in the hands of this Committee.

Our present purpose in appearing is principally to discuss certain considerations which have been given prominence since that time and which emphasize these points:

1. The seaboard section of the American industry has been seriously injured by foreign competition resulting in a large measure of unemployment.
2. A duty on cement should not be expected to increase prices of cement away from seaport markets.
3. The American cement industry operates under conditions of free and keen competition.
4. Uniformity of price to the consumer is the result of such competition.

The need for a tariff duty on cement was conceded by the Ways and Means Committee in its report on the pending bill in the following words:

"The domestic producers and the United States Tariff Commission have shown that the difference in cost of production in mills adjacent to the seaboard and that of Belgium cement (including transportation on both the domestic and foreign products to seaboard points in the United States) range from 38 cents to $1.16 per barrel, depending upon the point at which comparisons were made." (P. 26, Committee Report.)

Discussion of House Bill

The cement paragraph in the House bill carries a duty of 8 cents a hundred pounds, or 30.4 cents a barrel. This is less by eight cents a barrel than the figure which the Tariff Commission and the Ways and Means Committee found to be the minimum protective requirement for cement, and is 86 cents a barrel less than the maximum protective requirement as indicated by the proven differences between American and Belgian delivered costs. (P. 26, H. R. Committee Report.)

Of this duty Mr. Watson of Pennsylvania, chairman of the subcommittee of the Ways and Means Committee which framed the cement schedule, said in debate in the House on May 10th:

"The duty imposed will fall short of affording protection to the seaboard mills, which alone must meet competition from the foreign product.

"There are 158 mills in the United States, of which 86 are located along the seaboard. The question arises, shall we close the cement factories along the Atlantic coast?"

The duty proposed in the House bill, therefore, is in no practical sense a protective duty. It is the same duty carried, largely for purposes of revenue, in the long period from 1890 to 1913 when cement was on the protected list, so-called. (Table XI, P. 8823, H. R. Hearings.)

It is 43 cents a barrel less than the difference between American and Belgian mill costs of producing cement, disregarding transportation charges. (P. 8335, H. R. Hearings.)

It is 56 cents a barrel less than the demonstrated spread between the published mill prices of the two industries. (P. 8312, H. R. Hearings.)

It is 39 cents a barrel less than the average spread of delivered costs at the eight American ports which the report of the House subcommittee listed as receiving 88 per cent of all cement imports in 1928. (P. 25, H. R. Committee Report.)

The cement industry before the Ways and Means Committee proved:

1. That the duty asked would equalize foreign competition upon only 61 per cent of the foreign cement consumed in this country. (P. 8356, House Hearings.)
2. That Belgium cement manufacturers are protected by cartel agreements through which they are able to fix prices, limit production and allocate markets. (P. 8332, House Hearings.)
3. Foreign cement is forcing seaboard sections of the American cement industry to sell nearly 15,000,000 barrels annually at below cost. This is 80 per cent of all American cement sold in seaboard markets and nearly 10 per cent of total American production. (P. 8363, House Hearings.)
4. As a result of this competition, 48 per cent of American mills shipping to seaport markets operate at a loss. (Table V, P. 8322, House Hearings.)

Damage to Cement Industry

The comparatively small ratio which imports of cement by volume bear to total American shipments, is of purely academic interest in determining whether the American cement industry needs a protective tariff duty. Damage to the industry resulting from imports of cement is the only practical criterion, whether such imports represent one-tenth or ten times the volume shown. That this volume has been sufficient to accomplish the injury to the American industry complained of, due to dislocation of prices and sales at a loss, is fully recognized abroad. The National Bank of Belgium in its official bulletin last year, commenting on the cement situation, stated:

"As the price fight carried on by the American cement mills bears on an important tonnage, it is causing them considerable loss, quite out of proportion to the result to be attained." (P. 8311, H. R. Hearings.)

Effect of Tariff Duty on Cement Prices

Cement is sold at a lower price per pound than any other highly manufactured commodity; it nets the manufacturer an average of less than one-half cent a pound.

The claim that a price increase at seaboard can be carried back to inland points is an economic absurdity. The history of the cement industry clearly demonstrates that seaboard and inland cement price structures are independent of each other.

In order to assume that increased prices at seaboard would be reflected in increased prices at inland points, it would have to be shown that depressed prices at seaboard have been reflected in depressed prices inland. The fact is, as shown by government statistics (Mineral Resources of the United States, 1921-1927), inland prices have been least stable in years when seaboard prices were firm.

The trend of cement prices has been consistently downward throughout the history of the industry. In inland as well as seaboard markets this general trend has been accompanied by sharp variations from time to time, due both to general and local economic conditions.

If recent depressed prices at seaboard had affected prices inland, such effect on inland prices would be proportionate to the distance from seaboard. A study of cement prices for the years 1920 to 1927 shows that price reductions have frequently been greater at points far from seaboard than at points near seaboard.

The following table compares the wholesale prices of portland cement delivered in carload lots as of December, 1926, and December, 1927 (Mineral Resources of the United States, 1927, Part II, Pages 269, 298, United States Department of Commerce):

City	Distance from New York Miles	Net Change per bbl. (cents)
Kansas City, Mo.	1331	—28
St. Paul, Minn.	1307	—10
Davenport, Iowa	1127	— 5
St. Louis, Mo.	1053	—15
Indianapolis, Ind.	812	—10
Chicago, Ill.	903	— 5
Toledo, Ohio	701	No change

If foreign cement should be brought to any of the above cities on favorable commodity rail rates, its delivered cost would be from 39 cents to $1.33 more than the price at which American cement is sold in these same cities. Under these conditions, it is obvious a tariff duty on cement cannot affect the price of cement in these cities.

Dividing the years 1920-1927, inclusive, into two periods—the period in which foreign cement did not especially disturb seaboard markets, and that in which foreign cement did disturb seaboard markets, it will be seen that the price conditions at seaboard were in no wise reflected in price conditions inland. In the first period—1920 to 1924—seaboard prices dropped a net of only 15 cents, while inland prices dropped 28 cents; and in the second period—1925 to 1927—seaboard prices dropped precipitately, 35 cents, while inland prices not only remained firmer than seaboard, but firmer than they had been in the preceding period, dropping only 15 cents.

	Inland-Price Change cents	Seaboard Price Change cents
1921	—18	+ 3
1922	—12	—20
1923	+14	+ 9
1924	—12	— 7
1925	— 2	—12
1926	— 8	—13
1927	— 5	—10

During both periods the amount and sometimes the direction of price changes differed in each territory.

The excess capacity of the inland cement industry insures that local competitive conditions will continue to govern price trends, and inland price levels will continue to be independent of seaboard conditions. Government statistics show that in 1927 seaboard plants operated at 78.3 per cent of capacity, while interior mills operated at only 74.5 per cent of capacity.

That the deterrent effect upon price increases which excess of capacity over sales naturally imposes, will continue at inland points, regardless of tariff actions, is indicated by the fact that stocks on hand on May 31st, of this year, were 13.9 per cent greater than on the same date last year, according to government statistics just published.

These statistics also show that in the twelve months ended May 31, 1929, the industry operated at 70.2 per cent of capacity as against 73.9 per cent for the twelve months ended May 31, 1928.

From the foregoing it must be clear:

1. That the movements of inland and seaboard cement prices have been independent of each other, both with foreign competition and without it.
2. That this independence of the inland price structure is based entirely on local conditions of supply and demand.

A duty on cement, therefore, cannot be expected to increase inland cement prices.

Competition in the American Industry

The ratio of production to capacity for all American mills has dropped from 80 per cent in 1922 to 70 per cent in 1928.

The average mill net return has ranged downward from $2.02 a barrel in 1920 to $1.60 in 1928.

Uniformity of Prices

Uniformity of prices in a standardized commodity sold to fully informed buyers is the best evidence of unrestricted competition.

"There is for all practical purposes a unanimity of opinion among economists that with a standardized commodity and conditions of effective competition there is the strongest sort of tendency to uniform price"—Testimony Dr. Thomas S. Adams, Professor of Economy, Yale University. Cement Case U. S. District Court—Southern District of New York.

It is absolutely essential that a manufacturer should maintain his agencies throughout his territory. He cannot supply them with cement one day and withdraw from their market another, but must be prepared constantly to offer cement at as low a price as any competitor or else withdraw from the market entirely.

In order to get minimum cost, mills must operate at high capacity. Partial or total shutdown means heavy increase in cost. Thus cement sometimes is sold at or below cost in order to keep mills in operation. In markets where foreign cement enters there is also the desire to hold a place in the market looking to the time when the tariff will restore fair competitive conditions.

By reason of the fact that in the case of a bulky commodity like cement transportation is necessarily so large a factor, the delivered price of cement usually is the mill price of the mill nearest the job involved plus the actual cost of transportation from that mill to the job. Freight rates are published and frequent listing of prices at biddings on construction jobs keeps all persons fully informed as to what mill prices have been made by each plant.

The following statement by an American cement manufacturer taken from Professor Henry Parker Willis' book, "Portland Cement Prices," is typical of the experience by the entire industry:

"Although our base price was $2.10 (for a given year) we averaged for our cement sold from $1.72 to $1.85 per month. We ship our product in all directions, in competition with many mills. Obviously, the nearer our market points approach such mills, the more freight we would have to absorb in order to meet our competition at such points; albeit the mill or base prices of some of our competitors might be higher than others, thus correspondingly diminishing the amounts we would have to absorb to meet such competition."

The following quotations from the decision of the United States Supreme Court in the cement case (268 U. S. 588), previously quoted in connection with the vindication of the industry in the anti-trust case, are particularly illuminating:

"It is conceded that there is a substantial uniformity of price of cement. * * * It appears to be undisputed that there were frequent changes in price and uniformity has resulted not from maintaining the price at fixed levels, but in the prompt meeting of changes in prices by competing sellers. * * * A great volume of testimony was also given by distinguished economists in support of the thesis that in the case of a standardized product sold wholesale to fully informed professional buyers as were the dealers in cement, uniformity of price will inevitably result from active, free and unrestrained competition, and the Government in its brief concedes that 'undoubtedly the price of cement would approach uniformity in a normal market in the absence of all combinations between the manufacturers.' "

Preventive Action Needed

It is clearly recognized that the protective tariff policy must operate as a preventive of industrial disaster, as well as a remedy. The suspensions in some plants and reduced operations in others, while serious and demanding corrective measures, are most important as indicating the injury which logically may be expected to follow a continuation of such trade conditions.

Importation of foreign cement was limited to the relatively small total of two and one-half million barrels last year, solely by the action of American manufacturers in selling millions of barrels of cement at seaboard below cost, thereby restricting the American market and discouraging expansion of the invasion. European manufacturers, all of whom can produce and deliver cement in American seaboard markets at less than it costs American manufacturers to deliver to the same markets, are capable of expanding their present production by 72,000,000 barrels (Page 8315, House Hearings), or nearly three times the total seaport consumption of the United States.

That a large part of this available European surplus has not been turned into the American markets, has been due to the willingness of the American manufacturers to accept losses, pending expected tariff relief, and to continue to sell cement at below cost.

That the American manufacturer cannot continue indefinitely to hold the fort and sell cement at a loss in seaport cities, goes without saying. He must have tariff protection or go to the wall in seaboard markets. He has temporarily stalled off, at the cost of many millions of dollars, a large part of the unemployment and stagnation which otherwise would be the logical result of these conditions and which the protective tariff policy is designed to prevent. Other American industries have a protective duty to meet similar conditions. The cement industry needs an adequate tariff to insure the balance with other industries necessary to the prosperity of all. It looks for tariff relief. It should receive it promptly and ungrudgingly from this Congress.

The Hydrolysis of Cement Mortar Briquettes

By L. C. JENNESS and H. B. BOURNE

Recent work done by the authors indicates that certain chemical properties of a sand are effective on their mortar strengths.[1] This being especially true of the hydrogen-ion concentration of sand extracts, an attempt was made to determine what relationship, if any, exists between the hydrogen-ion concentration of solutions in which cement mortar briquettes have been immersed and the strength of the briquettes.

The hydrogen-ion concentration was determined electrometrically. Ten sands were selected of widely varying acidity and made into standard briquettes of a 1:3 ratio. Individual briquettes were immersed in 800 c. c. of distilled water, which was changed every day for the first two weeks, and every three or four days thereafter for two weeks. The water was changed in every case one day previous to the taking of the reading.

The average *pH* at the end of the second day was 11.57, with a maximum deviation of 0.08. The *pH* values decreased rapidly for the first seven days, the average being 10.9, and slowly thereafter until at the end of 28 days the average was 10.69. Although the 28 day mortar strengths varied from 200 lb. per sq. in to 600 lb. per sq. in., the variations of *pH* were so small and irregular that no relationship could be detected.

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[1] Gowen, J. W. and Leavitt, H. W.: Influence of Iron Content on Mortar Strength, *Proc. Nat. Acad. of Science*, Vol. 13, No. 6, June, 1927, pp. 351-4.

New Cement Plant for New South Wales

The first unit of what is said to be one of the most up-to-date plants of its kind in the world has been opened at Berrima, New South Wales, for the production of cement on an extensive scale. The plant is that of the Southern Portland Cement, Limited, and when completed will be valued, with subsidiaries, at £1,000,000 ($5,000,000). Both English and Australian interests are associated in the venture. The first unit, which commenced operations early in 1929, has a capacity of 75,000 tons of cement per year, and that will be doubled when the second unit is put into operation. The general equipment of the undertaking includes a coal mine, which will have an output of 1,000 tons per day, limestone quarries at Marulen, from which the raw material will be transported 30 miles for treatment, a dam on the Berrima River holding about 200,000,000 gallons of water, a pumping station, and a power plant generating 2,200 volts.

Propose Merging of Medusa and Newaygo Companies

Plans calling for the merger of the Newaygo Portland Cement Company, Newaygo, Mich., with the Medusa Portland Cement Company, Sandusky, Ohio, were announced late in July by J. B. John, general manager of the former company and president and general manager of the Medusa company. It is also reported that the Manitowoc Portland Cement Company plant is included in this merger.

This will give the Medusa company its first lake port and also an 800-acre tract of land in the Charlevoix, Mich., district. One result of the merger will be the speeding up of action in the erection of a new plant, quarry and harbor on the land.

Under the terms of the merger the Medusa company will acquire a majority of the outstanding voting or common stock of the Newaygo company and also a majority of the Newaygo company's only other class of stock—its outstanding preferred stock. The acquisition of Newaygo stock will be accomplished by exchanging one and three-fourths shares of Medusa no-par-value common stock for each one share of Newaygo stock, and by exchanging Medusa Series A 6 per cent cumulative preferred stock for Newaygo 7 per cent cumulative preferred stock, share for share.

The combined capacity of the Medusa plants is 6,000,000 barrels yearly, while the Newaygo plant is equipped to turn out 2,000,000 barrels of cement annually.

Under the terms of the merger J. B. John, general manager of the local plant, will continue as head of the Medusa company and the board of directors of that company will be reconstituted to include three of the Newaygo group, C. H. Hollister, L. E. Geer and C. C. West. Mr. John is a member of the board of directors of the Medusa company and under the new management Mr. West will become a vice-president of that concern.

The Newaygo company will continue to operate its plants and market its products under present brands.

The deal will not become effective, however, unless a majority of the common and preferred shares of the Newaygo company will have been deposited by September 1st.

Stockton, Calif., Definite Location of New Plant

Stockton, California, has now been definitely named as the location of the 1,300,000 barrel cement plant to be erected by the Port Stockton Cement Company. A 29-acre site on the Stockton deep water channel has been selected.

The plant will be supplied with limestone from the 900-acre quarry near Columbia, Calif. Clay will be pumped to the plant from a supply nearby.

The proposed system of disposing of the finished product calls for the erection of storage silos in San Francisco and Oakland, from which the sacked cement and bulk delivery will be made by truck, rail and water. Tank barges will be used over the water.

Other plans of the company include the purchase of a clay deposit of ninety acres of the San Joaquin river and, construction of six miles of railroad from the quarry to the plant.

Fuel oil will be brought back in separate compartments of the same barges on the return trip from San Francisco bay refineries.

The firm will be capitalized at $3,250,000 for the first unit.

Election of Port Stockton company officers took place on August 12th, when William Sherman was named president.

Elected to serve with him on the board of directors are Emory E. Smith, president, Smith-Emory Company, chemical engineers; W. C. Stevenson, chief engineer of the company and formerly chief engineer for the Pacific Portland Cement Company, Yosemite Cement Company and the Pacific Portland Cement Company; Charles H. Segerstrom, president of the First National Bank of Sonora; F. B. Hyder, mining engineer and formerly associated with D. C. Jackling; Joseph McInerney, and Alfred E. Roberts, consulting engineer and designer of several mills located on the Pacific Coast.

Southwest Cement Shipments Show Rise for Second Quarter

The Kansas City Cement Bureau, serving Arkansas, Kansas, Western Missouri, Nebraska, Oklahoma and Texas Panhandle, reports that the mills located in this territory shipped into same during the second quarter of 1929 a total of 2,703,172 barrels of portland cement, as compared with 2,357,092 barrels during the second quarter of 1928.

These mills shipped into the above territory during the first half of 1929 a total of 4,010,897 barrels of portland cement, as compared with 3,952,616 barrels during the first half of 1928.

At the end of June, 1929, these mills had in stock 1,488,527 barrels of finished portland cement, as compared with 1,570,154 at the end of June, 1928; and had unshipped commitments on contracts for specific work in the above territory of approximately 1,655,000 barrels of portland cement, as compared with approximately 1,293,989 at the end of June, 1928.

"Pit and Quarry" Absorbs "Cement Mill and Quarry"

According to announcement made by the Complete Service Publishing Company, Chicago, it has purchased the publication "Cement Mill and Quarry" and will combine it with its own magazine, "Pit and Quarry."

The combined publication, as was the case when each was published separately, will continue to cover the field of sand, gravel, crushed stone, cement and other phases of the nonmetallic minerals industry.

Ohio Interests Making Survey of Iowa Land

An Ohio company is reported to be making a survey of land near Osage, Iowa, looking toward its suitability as a cement plant site. Options on two farms have been obtained and drilling tests are under way.

Calaveras Acquires Limestone Reserve

The Calaveras Cement Company, San Francisco, Calif., has acquired 140 acres of lime deposits in the Rich Gulch section near its plant at San Andreas, Calif.

The acquisition was made for a reserve supply.

Norfolk Mill Closed

The Norfolk mill of the Lone Star Cement Company of Virginia, Inc., closed down on August 11th for an indefinite period. It had been operating on a reduced output with several shutdowns in recent months.

Spanish Cement Plant

Located Adjacent to

Rich Raw Materials

A Description of the Newest Plant of the Compania General de Asfaltos y Portland "Asland," Villaluenga, Spain

Part II

(Concluded from August issue)

Clinker

From the kiln the clinker passes to the cooler, which lies immediately below and in prolongation of the kiln. The cooler, made by Allis-Chalmers, is 8 ft. in diameter and 63 ft. long, and is operated by a 20-h.p. motor, with its speed reduced from 750 to 80. It discharges the clinker into a bin, at the bottom of which is an iron hopper, from which the clinker drops to the 1000-kilogram scales, where it is weighed. It then passes to an 8- by 16-in. bucket elevator, 15 meters (48 ft.) high. This carries the clinker to an inclined, 14-in. belt conveyor 13.75 meters (44 ft.) long, which is cooled by a spray of water before receiving the clinker, in order to prevent it from being burnt. This conveyor discharges the clinker upon a horizontal 14-in. belt conveyor placed at right angles to the first, running along the highest part of the roof of the clinker bin and 28.75 meters (92 ft.) long. This conveyor, in turn, discharges the clinker at any desired part of the bin by means of a distributing car equipped with a Tripper; each of the two conveyors is driven by a 12-h.p. motor, the speed being reduced from 750 to 30.

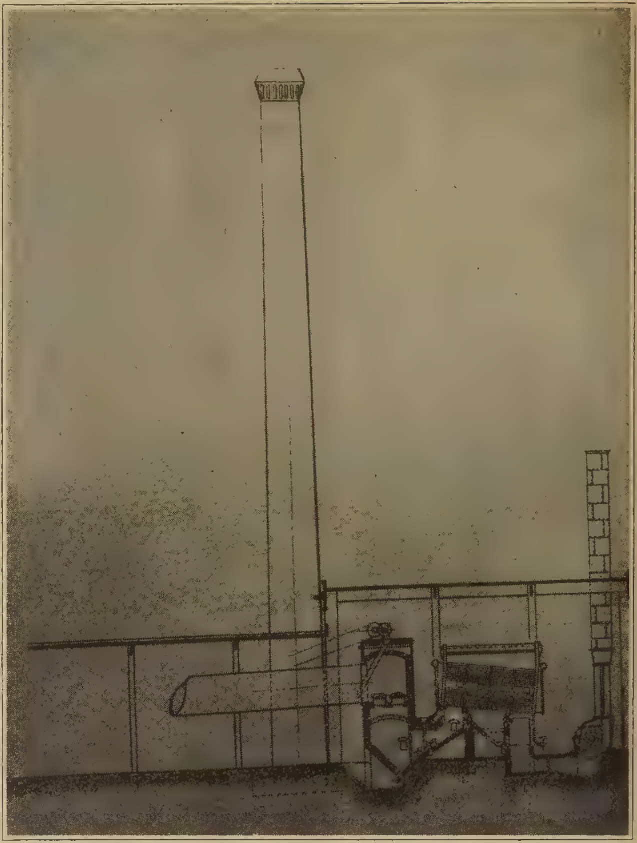
The clinker bin consists of a pit or storage place lying below the level of the cooler. It is 28 meters (90 ft.) long, 14.80 meters (47 ft.) wide at the top, roofed with reinforced concrete at a height of 13 meters (42 ft.) in the clear, and holds approximately 10,000 tons. In its bottom are 10 openings having iron hoppers and swing chutes, which allow the clinker to drop upon a 14-in. inclined belt conveyor, 64 meters (205 ft.) long, running in a reinforced concrete tunnel which passes beneath the clinker bin. This tunnel, which is 2.10 meters high by 2.20 in width (approx. 7 sq. ft.), runs underground for a distance of 46 meters (147 ft.), and is continued on the surface, as a covered passage, for another 14 meters (45 ft.), alongside of the building containing the scales for adding gypsum. The conveyor discharges the clinker upon two 1000-kilogram scales, where it is weighed, and the necessary amount of gypsum added through a small hopper installed between the scales, the quantity being regulated by the weigher by means of a lever. The conveyor described and the mechanism of the gypsum scales are operated by a 12-h.p. motor, the speed being reduced from 750 to 30. The clinker scales discharge their loads upon

General view of the plant, showing the enclosed belt conveyors that transport raw materials from the quarry to the plant

a 14-in. inclined belt conveyor, running at right angles to the one just described. This second conveyor, which takes the clinker to the cement mill storage bin, is 35.50 meters long and is placed inside of an enclosed metal bridge, covered with reinforced concrete and resting on supports of the same material. The bridge is 2.20 meters wide and 2.10 meters high (approximately 7 ft. sq.), its discharge end resting upon the cement mill building. The conveyor is operated by a 12-h.p. motor, whose speed is reduced from 750 to 30 r.p.m.

The storage bin of the cement mill is of reinforced concrete. It is cylindrical in shape, 4.40 meters (14 ft.) in diameter and 5 meters (16 ft.) high, with a capacity of 90 tons of clinker, and stands on reinforced concrete pillars. The mill is a 7- by 26-ft. Allis-Chalmers compeb, like that used for the raw material, and has a capacity of 10 tons of cement per hour. It is connected by means of a magnetic clutch with a 500-h.p. Allis-Chalmers synchronous 2200-volt, alternating-current motor, and is fitted, at its discharge end, with a chute which carries the ground cement to a 14-in. inclined belt-conveyor running inside of a metal bridge covered with reinforced concrete, 50 meters (160 ft.) long, 2.20 (7 ft.) wide and 2.10 (7 ft.) high, the upper end resting upon the cement bins.

These, six in number, are built of reinforced concrete. They are cylindrical in form, with a diameter of 5.50 meters (18 ft.) and a height of 15 meters (48 ft.); their walls are 8 in. thick and they have a capacity of 500 tons each. In addition, in the spaces enclosed by four bins each, there are two smaller ones holding 200 tons each. The entire group of bins stands upon a solid block of concrete which distributes the pressure upon the surface and keeps it within the limits imposed by the nature of the ground. Through this concrete block and beneath the center of the bottoms of the bins runs a tunnel, in the walls of which are 16 openings for the discharge of the cement, covered by iron rack-and-pinion gates. The cement as it comes from these openings, drops into a worm conveyor, 16 in. in diameter and 25 meters (80 ft.) long, which passes through the entire length of the tunnel and collects the cement from all of the bins, taking it to the pit of an 8- by 16-in. bucket elevator 14 meters high, which carries the cement to the bagging house.


Cross section of the boiler and kiln department

The sack house is a building with 3 stories and an upper loft, constructed entirely of concrete, 26 meters (83 ft.) long, 13.50 meters (43 ft.) wide and 12.50 meters (40 ft.) high. On the first floor is a Bates bagging machine with two pipes, which receive the cement after it has passed through a sieve on the second floor where it has been deposited by the elevator from the cement bins. The building stands between two railroad tracks of the standard Spanish gauge, allowing the cars to be brought close up for loading, which is done directly from the bagging machine, the sacks of cement being taken in hand-trucks to the railroad cars. The second story of the building is used for sorting and repairing sacks, and in the loft is a machine for shaking them out. This consists of a polygonal wooden drum 5 ft. long and 10 ft. in diameter, its sides being formed of wooden slats, latticed to leave openings for the escape of the cement which is collected in an iron hopper at the bottom of the drum.

The Raymond mills and clinker cooler

The different stories are connected with each other by means of hoists, to facilitate the handling of the sacks.

Utilization of Waste Heat

The gases, on leaving the kiln, pass through the gas chamber of the same and escape from the bottom of the chamber into the gas flues of the boilers. The dust carried by the gases is first precipitated in the gas chamber, where it falls to the bottom, whence it is taken by a 16-in. screw conveyor 15 meters (48 ft.) long which carries it to the elevator that feeds the kiln. The heated gases pass through the tubes of an Edge Moor boiler, which have a heating surface of 11,000 sq. ft. This boiler, built to stand a pressure of 200 lbs., is equipped with a Foster super-heater and a Foster economizer, with an induced draft fan built by the Green Fuel Economizer Co.

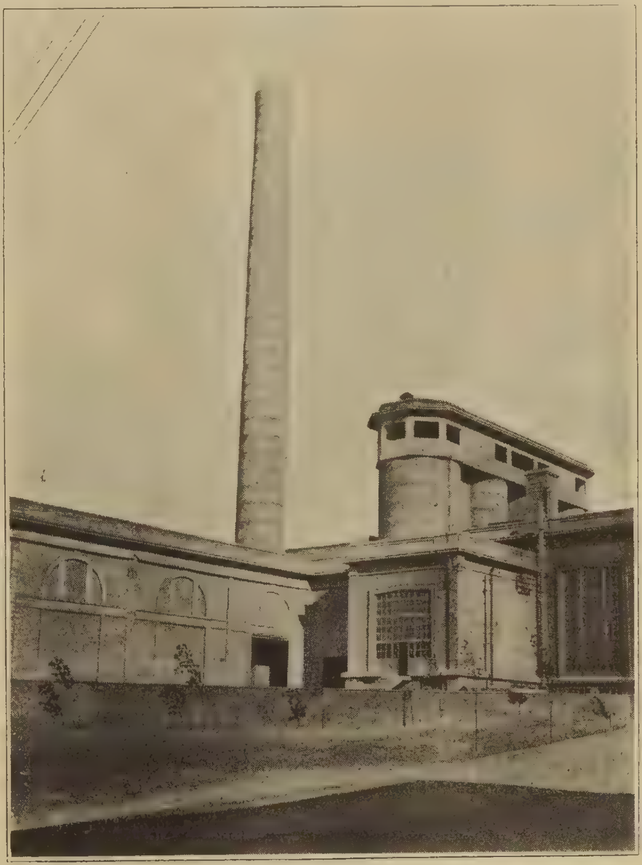
Conveyors for distributing clinker to storage

The fan is driven by a 150-h.p. variable speed motor, to permit the regulation of the draft and of the expulsion of the gases through an iron chimney 5 ft. 6 in. in diameter at the mouth and 64 ft. 4 in. high. The steam from this boiler drives an Allis-Chalmers 1600-kw. alternating-current turbo-generator with an 80 per cent efficiency at 3000 r.p.m.; the high pressure turbine of the condenser type works with steam at a pressure of 185 lbs., superheated 100 deg. Fahrenheit, and a vacuum equivalent to 28 in. of mercury. The generator, which has a direct-connected exciter, is 3-phase, 50-cycle, 2300-volt. Operating in conjunction with the turbine is a horizontal cylindrical Allis-Chalmers surface-condenser with a condensation surface of 2600 sq. ft. and a diameter of 48 in. It is equipped with a centrifugal pump which expels the condensed water at the rate of 60 gallons per minute. The condenser is cooled by cold water, circulated by a 12-in. Allis-Chalmers centrifugal pump handling 3000 gallons a minute, operated by a 30-h.p. Allis-Chalmers motor, the water being taken from a reservoir of reinforced concrete 40 meters (128 ft.) long, 25 meters (80 ft.) wide and 1.45 meters (4.7 ft.) deep, and being returned to the same through an 18-in. cast-iron pipe 118 meters (378 ft.) long which connects the condenser with the cooling reservoir.

Driving mechanism for coal dryer

Water Supply

The water needed for the operation of the factory comes from springs lying about 3 kilometers (2 miles) away, whence it is delivered by two 3-piston vertical Worthington pumps with a capacity of 228 gallons per minute, through a 4-in. wrought iron pipe. It is stored in two cylindrical reserve tanks, built of reinforced concrete 5.50 meters (18 ft.) in diameter and 12 meters (38 ft.) high, and from them is distributed to the factory. That needed for the boilers goes through a Zerolit purifier 915 millimeters (3 ft.) in diameter with a capacity of 12 cubic meters (3 sq. ft.) between fillings, and from there to the boiler feed tank, also of reinforced concrete, 5.50 meters (18 ft.) in diameter and 8 meters (3 ft.) high. The boilers are fed by two Dean Brothers Durable Duplex pumps, 8-in. and 5- by 12-in.



Power house and kiln stack

(To Be Continued)

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75% misquotations!

Florida Plant Reopens with Doubled Capacity

The Florida Portland Cement Company plant at Tampa resumed operations on a doubled capacity scale on Monday, August 5th. It had been closed for the past several weeks for construction work necessary for the increased capacity. It can now handle 175 cars of raw material a day.

Expansion of the sales policy of the Florida Portland Cement Company with a view to exporting the Tampa product to Cuba, the West Indies, Central and South America, is being adopted, according to S. W. Storey, vice-president, who visited the plant prior to the reopening.

"The company has been encouraged with bright prospects for future business," Mr. Storey said.

"Our output for Florida sales this year has exceeded last year by 100,000 barrels and we anticipate a better business for the remainder of the year.

"Markets seem to be opening up for us south of Florida, and we already have made shipments to Cuba and Panama. This, with a steadily increasing Florida trade, gives us complete confidence in facing the future with our Florida product.

Representative in Peru

"We hope to make shipments from Tampa to the Bahama islands, Leeward and Windward islands, Central America and northern countries of South America. We have a man in Peru looking after our interests there and the entire Pacific coast of the continent may be within our reach in supplying their needs."

The Tampa plant to supply this territory represents an outlay of approximately $7,000,000 and has an available output of 1,600,000 barrels of cement a year, which is 300,000 more than all the cement used in the entire state during 1928. However, the company considers a normal Florida year will give a consumption of 2,000,000 barrels, and this normal condition is steadily being approached.

Cement Reference Laboratory Begins Work of Inspection

The Cement Reference Laboratory, recently established at the Bureau of Standards, under the sponsorship of Committee C-1 on Cement of the American Society for Testing Materials has begun the inspection of cement testing laboratories as part of the program to secure improvement in the testing of cement. The inspectors are now in the field, caring for some of the requests already received. There is no fee for the work done in the field.

However, the inspectors will visit only those laboratories which request their services and it may not be possible for them to visit some localities very frequently.

Present Limestone Quarry to Furnish Raw Material to New Oklahoma Plant

Initial announcement of a $1,800,000 cement plant industry for the Tulsa, Oklahoma, region was made late in July by Clarence B. Douglas, Tulsa attorney and industrial advocate.

The plant, which will have a capacity of approximately 500,000 barrels annually, will be located at Lost City, on the south bank of the Arkansas, about midway between Tulsa and Sand Springs.

The company, as yet unformed, will when organized probably center about the Krause brothers of St. Louis, who purchased the present plant, being operated as a commercial limestone quarry, about nine months ago and who are said to be the largest producers of commercial limestone in the Mississippi valley industrial area. E. J. Krause will proably head the company and make his headquarters in Tulsa to direct all operations.

The Zenith Limestone Co., which is the present name of the stone-crushing concern, owns 160 acres of limestone bluffs, fronting some three-quarters of a mile along the river from west of the Mid-continent refinery. In addition, there are reserves of 240 acres of such lands east of the city under ownership of the concern. In addition to these holdings and the existing properties in the way of buildings and a crusher plant, there will be installed some $75,000 worth of new equipment to transform the plant and increase its capacity.

Program of Safety Council Cement Sessions Announced

Aside from the annual report by the general chairman, the first paper on the program of the Cement Section of the Eighteenth Annual Safety Congress to be held in Chicago at the end of September is a symposium on screw conveyor accidents, by M. L. Humphryes, mechanical engineer for the Universal Portland Cement Company.

The congress is sponsored by the National Safety Council and is being held on September 30th to October 4th, at the Stevens and Congress hotels. Cement Section sessions will be held Tuesday and Wednesday, October 1st and 2nd.

Three other papers among those to be presented are "Fatal and Permanent Disability Accidents in the Cement Industry," by W. H. Weitknecht, superintendent for the Lehigh Portland Cement Co., "Safety Practices in the Quarry," by T. Quigley, chief of the quarry section of the Department of Labor and Industry, and, "Putting Punch Into a Safety Campaign," by Jack Dempster of the Canada Cement Co., Ltd.

Penn-Dixie Profits for Past Year Below Previous Twelve Months

The Pennsylvania-Dixie Cement Corporation, for the twelve months ended June 30th, reports a net profit of $975,813, after depreciation, depletion, interest and federal taxes, against $1,360,933 in the preceding year.

This profit is equal to six cents a share on the 400,000 common shares, against $1.02 a share for the preceding twelve months.

Oklahoma Raw Materials Plentiful

That Oklahoma, particularly the eastern part of the state, should never run short of raw material for cement manufacturing, is the essence of a report by Dr. Charles N. Gould, director of the Oklahoma Geological Survey.

While there are two plants manufacturing portland cement in Oklahoma—one at Ada and the other at Dewey—there are possible locations for many more should conditions justify them, it continues.

Santa Cruz Completes Laying of Ocean Pipeline

The Santa Cruz Portland Cement Company, San Francisco, Calif., has completed the laying of a half-mile pipeline on the floor of the Pacific. It conveys fuel oil from tank steamers in the bay to storage tanks on the mainland.

~~ EDITORIAL ~~

Brand Names

PRACTICALLY every outstanding merchandising accomplishment in the business world has revolved around some particular brand name or some particular quality that has become associated in the purchaser's mind with the brand name.

In cement merchandising, also, there is evidence of such a trend. Whether the brand name is given to the product of a single manufacturer or to the product of a group of manufacturers, the user associates the brand name with some particular quality of the product carrying it or with some unique sales argument.

Co-operative advertising has built confidence in "portland cement" and has been of untold value to the industry in enlarging its market and in bringing about the acceptance of concrete as a superior building material. Its purpose is entirely different from that of the individual manufacturer who capitalizes that confidence in cement to point out the reasons for buying his particular brand. The present differentiation in cements makes brand names of greater importance than before.

Public Relations

WHENEVER a situation such as the present one regarding the need for a protective tariff comes before an industry, the importance of satisfactory public relations between the industry and the user as well as the general public is brought into the foreground. At such times, when public confidence is needed "right now," it is a difficult matter to capture it in a few short weeks.

This is a buyer's market. Users of cement feel that they can dictate their requirements. Practically universal perusal of newspapers and magazines has brought the interest of the general public to a point where it believes itself capable of rendering a decision on any subject, whether it be world disarmament or a tariff on cement. Whether or not that decision is just depends largely, if not entirely, upon the efforts made by those interested to instruct the user or the public. The fact that those forces outside an industry ***are*** interested may be irksome, but it is, nevertheless, a fact that must be reckoned with. It is of major importance to obtain and to hold the good will of the public.

In connection with the present effort to secure a protective tariff there are indications that some of the old "bogies" are still very much alive in the minds of the public—and also in the minds of the buyer and the user of cement. The feeling that cement manufacturers are making exorbitant profits and that they are organized as a monopoly to control prices (absurd as it is) is still not entirely done away with.

There is a feeling that the industry is "high hatting" the public—that it maintains secrecy because it has something to hide. And, strange as it may seem, that feeling is not entirely lacking among users of cement, either.

It is true that the cement industry has not taken the user nor the public into its confidence to the extent that it could profitably do so. Constant attention to this problem is needed. The public as well as the user demands that the industry keep him informed. They demand this in return for their support and confidence.

The Chemist

RECENTLY an executive of a Western cement manufacturing company was asked what type of advanced training is most important in the cement industry.

His reply was: "Chemistry first. A high class chemist, producing a uniform output of good quality is the most important feature of cement manufacturing."

The importance of chemical control in manufacturing cement has always been recognized to some extent. It has been particularly emphasized in the last few years and it will be of even greater importance in the years immediately ahead. The cement plant laboratory will be the hub around which the activities of the plant revolve.

When cement specifications were advanced to their present requirements attention was largely centered on grinding methods. The present proposed advance is centering attention on chemical control, proportioning of raw materials and blending. Testing methods and laboratory equipment are being scrutinized as never before. Not only from a manufacturing point of view, but also from a merchandising point of view is the work of the chemist and his laboratory being brought into the limelight.

The cement manufacturer must look to the laboratory for a solution of many of the problems that are now confronting him. Upon proportioning and blending depend the success of many of the plant operations. Uniformity of the finished product has become of steadily increasing importance. And when the product is completed it is necessary more than ever before to have it tested under standard conditions so that test results will be more nearly uniform.

All these activities come within the scope of the chemist. His work deserves the highest consideration of the industry.

Calcium Sulphate Retarders for Portland Cement Clinker

AN investigation of the use of calcium sulphate for retarding the set of portland cement clinker has been conducted by the United States Bureau of Mines, Department of Commerce. A definite control of the time of set of portland cement is one of the problems which has been of primary interest to this industry and the main purpose of the investigation was to develop a wider field of utilization for natural anhydrite.

While it is conceded that the grinding of the proper percentage of gypsum or plaster of Paris with portland cement clinker will bring about a condition that leads to a normal setting cement, it has not been definitely established that natural anhydrite is equally efficient. Some of the gypsum deposits are contaminated by quantities of anhydrite mixed with the gypsum. Other deposits that are now relatively free from this difficulty may be troubled with it within the next generation. Since natural anhydrite, or gypsum which is mixed with an appreciable amount of anhydrite, is not suitable for the production of calcined gypsum products, a field for the utilization of this material would be of considerable value to the gypsum industry. Committee C-11 on gypsum, of the American Society for Testing Materials, recognized the importance of obtaining definite information on the utilization of anhydrite and requested the Nonmetallic Minerals Experiment Station of the Bureau of Mines to undertake a study of the action of anhydrite as a retarder for portland cement.

In September, 1925, the Bureau of Mines published Serial 2705, giving the results of an extensive series of tests on the retarder problem. This report indicates that mixtures of plaster of Paris and anhydrite will generally retard the set of portland cement clinker, but that straight anhydrite is of questionable value. Twenty different samples of clinker were tested, but only one anhydrite was used in this first series of tests.

It is generally believed that the action of calcium sulphate as a retarder is closely related to its rate of solubility. The rate of solubility, in turn, depends upon the physical and chemical properties of the calcium sulphate, and as there is wide variation in the physical properties of the natural anhydrite obtained from different localities it seemed that some samples of anhydrite might react differently from others when used as retarders for cement clinker. Consequently, the question arose as to whether or not the results obtained with one sample of anhydrite would be generally applicable to mill conditions, and research was extended to determine whether the type of anhydrite or its degree of fineness would affect its action as a retarder for portland cement.

Conclusions from New Tests

Following this request, the Bureau of Mines undertook a series of tests with three additional samples of natural anhydrite and one of by-product material, the results of which tests may be summarized as follows:

Better and more uniform results were obtained on samples of cement when the retarder and clinker were ground together than when the clinker and retarder were ground separately. Consequently, the former results should be used primarily to compare the action of different retarders.

Cement retarded with gypsum is more plastic than that retarded with straight anhydrite, and cement retarded with plaster of Paris is more plastic than that retarded with gypsum.

Cement retarded with straight anhydrite requires a higher percentage of sulphur trioxide than cement retarded with gypsum or plaster of Paris. It would therefore not be possible to use anhydrite with samples of clinker that require the maximum percentage of sulphur trioxide as gypsum for proper retardation.

The action of plaster of Paris differs from that of the other forms of calcium sulphate in that while it requires the smallest percentage of sulphur trioxide to produce a normal-setting cement, larger percentages constitute an excess which produces a quick-setting material.

The tensile strength of cement that has been ground with gypsum in a ball mill of 200 pounds capacity is no higher than the strength of cement that has been ground with anhydrite in a similar manner. However, the calcination of the gypsum in the large tube mill changes its properties, so that its reaction when ground at the plant should be similar to that of plaster of Paris mixed with clinker in the laboratory.

The tensile strength of cement retarded with plaster of Paris is consistently higher than that of cement retarded with other forms of calcium sulphate. However, the amount of sulphur trioxide as plaster required for maximum strength may be in excess of the amount that will produce a normal-setting cement.

When anhydrite is mixed with equivalent proportions of gypsum and plaster of Paris, a smaller amount of sulphur trioxide is required for normal set than when straight anhydrite is used. However, the required percentage of sulphur trioxide is slightly larger than that when straight gypsum or plaster of Paris is used.

If properly retarded, the strength and plasticity of cement containing equivalent proportions of anhydrite and plaster of Paris are practically the same as those of cement retarded with plaster of Paris, while the quality of a normally retarded cement containing an equivalent mixture of gypsum and anhydrite is equal to that of cement retarded with straight gypsum. This conclusion is substantiated in mill practice, as many cement plants are using retarders that contain a considerable percentage of anhydrite and are obtaining satisfactory results. There has been a tendency, however, to assume that anhydrite is a successful retarder, while the information available shows only that mixed gypsum and anhydrite may be successfully utilized as a retarder. This conforms to the results obtained in the present investigation.

The results obtained with all three types of natural anhydrite tested were practically the same. The by-product used in this series of tests was less effective than the natural anhydrite.

The relation between the action of the different forms and mixtures of calcium sulphate noted in this main series of tests is similar to that noted in the former investigation conducted by the Bureau of Mines in which 20 samples of cement clinker were tested.

1928 Cement Production Tops All Records

Production 2 Per Cent Over 1927, Previous Highest Year —Like Increase in Shipments and Stocks, According to U. S. Bureau of Standard Statistics

STATISTICS relating to the portland cement industry in 1928 compiled by the United States Bureau of Mines, Department of Commerce, from the final returns of the producers for the year, which are, however, still subject to revision, confirm the estimates published by the Bureau of Mines early in January.

Production of portland cement in 1928—176,195,488 barrels—was the largest quantity manufactured thus far in any year, exceeding that in 1927, the next highest year in production, by 2 per cent.

Shipments of portland cement from mills in 1928 amounted to 175,734,974 barrels, valued at $275,885,902, an increase of 2 per cent in quantity and a decrease of 1.1 per cent in gross value. The average factory price per barrel in bulk in 1928 was $1.57, a decrease of 5 cents per barrel as compared with 1927.

Stocks at the mills also increased, reaching a total of 22,917,896 barrels on December 31, 1928, the greatest at the end of any year during which official records of stocks have been kept. They were about 2 per cent higher than at the end of 1927.

From the reports of the producers showing mill shipments of portland cement into the various states estimates of per capita consumption in the accompanying table have been compiled. These are at best but approximations, as they represent only the records of mill shipments into states; they do not include the imports, which would increase the consumption in certain states near the Canadian border and the seaboard, nor do they make allowance for a variable but considerable stock of cement at all times in transit, in warehouses at distributing points, and awaiting use at jobs.

The commercial capacity for production of finished portland cement of the 156 plants active at the end of 1928, and of three plants idle in 1928 but producing within the two previous years, according to manufacturers' reports supplemented by a few estimates, was 243,252,000 barrels. This total includes besides increased capacity due to extensions and improvements at old plants approximately 3,900,000 barrels capacity for finished portland cement of 4 new plants that began operating during the year and are located one each in Maine, Pennsylvania, Tennessee, and Washington. The total production for the year 1928 was 72.4 per cent of the indicated capacity at the close of the year. The corresponding figure for 1927 from the producers' reports was 76.3 per cent.

A summary of the monthly estimates of output of portland cement in 1928, compiled from the monthly reports

PORTLAND CEMENT MANUFACTURING CAPACITY OF THE UNITED STATES, BY COMMERCIAL DISTRICTS, 1928

District	Estimated capacity (barrels)	Percentage of capacity utilized
Eastern Pennsylvania, New Jersey, Maryland	50,945,000	77.9
New York and Maine*	17,037,000	67.4
Ohio, Western Pennsylvania, West Virginia	24,671,000	74.3
Michigan	19,508,000	71.0
Wisconsin, Illinois, Indiana and Kentucky	26,607,000	85.5
Virginia, Tennessee, Alabama, Georgia, Florida and Louisiana	24,667,000	64.7
Eastern Missouri, Iowa, Minnesota, So. Dak.	22,993,000	72.6
Western Missouri, Nebraska, Kansas, Okla.	14,598,000	74.9
Texas	7,700,000	82.4
Colorado, Montana and Utah	5,567,000	49.8
California	22,700,000	59.3
Oregon and Washington	6,259,000	63.3
	243,252,000	72.4

*Maine began producing in April, 1928.

PORTLAND CEMENT PRODUCED, SHIPPED, AND IN STOCK IN THE UNITED STATES, 1927 AND 1928, BY DISTRICTS

	Production					Shipments							Stock (Dec. 31)		
	Active plants		Barrels		Increase or decrease 1928 (per cent)	1927		1928		Average factory value per barrel		Increase or decrease in quantity 1928 (per cent)	Barrels		Increase or decrease 1928 (per cent)
District	1927	1928	1927	1928		Barrels	Value	Barrels	Value	1927	1928		1927 (revised)	1928	
E. Pa. N. J. and Md.	24	25	42.687.200	39,677,010	— 7	41,656,489	$ 64,614,336	39,738,910	$60,236,388	$1.55	$1.52	— 5	5,471,989	5,410,089	— 1
N. Y. & Me.*	11	12	10,775,375	11,484,054	+ 7	10,531,092	16,380,090	11,357,052	17,386,416	1.56	1.53	+ 8	1,528,718	1,655,720	+ 8
Ohio, W. Pa. and W. Va.	18	18	17,339,199	18,326,478	+ 6	17,202,341	27,638,726	18,037,131	28,375,472	1.61	1.57	+ 5	2,571,795	2,861,142	+11
Michigan	15	14	13,965,241	13,848,561	— 8	13,708,259	20,858,202	14,044,230	19,628,495	1.52	1.40	+ 3	2,206,202	2,010,533	— 9
Wis., Ill., Ind. and Ky.	11	11	22,022,150	22,748,604	+ 3	22,394,739	36,274,654	22,627,309	35,575,358	1.62	1.57	+ 1	2,614,241	2,735,536	+ 5
Va., Tenn., Ala., Ga., Fla. & La.	18	19	16,016,154	15,949,537	— 4	15,530,338	23,668,315	15,770,338	21,253,288	1.52	1.35	+ 2	1,680,032	1,859,231	+11
E. Mo., Iowa, Minn., S. D.	11	12	14,358,201	16,692,696	+16	14,566,818	23,325,158	16,544,026	25,777,858	1.60	1.56	+14	2,731,067	2,879,737	+ 5
W. Mo., Neb., Kan., Okla.	11	11	10,092,888	10,938,637	+ 8	10,250,532	16,809,793	11,221,802	17,444,193	1.64	1.55	+10	1,629,230	1,346,065	—17
Texas	7	7	5,655,835	6,345,604	+12	5,692,350	10,232,908	6,231,083	10,938,646	1.80	1.76	+10	407,403	521,924	+28
Colo., Mont. & Utah	8	7	2,179,241	2,771,863	+27	2,293,514	4,692,136	2,628,003	5,696,187	2.05	2.17	+15	380,450	524,310	+38
California	12	12	14,580,654	13,452,221	— 8	14,433,153	26,623,396	13.596,493	25,552,069	1.84	1.88	— 6	840,506	696,234	—17
Oreg. & Wash.	7	8	3,534,375	3,960,223	+12	3,605,103	7,736,933	3,938,597	8,021,532	2.15	2.04	+ 9	395,749	417,375	+ 6
	153	156	173,206,513	176,195,488	+ 2	171,864,728	$278,854,647	175,734,974	$275,885,902	$1.62	$1.57	+ 2	22,457,382	22,917,896	+ 2

*Maine began producing in April, 1928; shipping in May, 1928.

of producers, was published early in January, 1929, by the Bureau of Mines. These estimates, which indicated a production of 175,968,000 barrels and shipments of about 175,455,000 barrels, were within 0.1 per cent and 0.2 per cent, respectively, of the figures for 1928 here presented.

SHIPMENTS OF DOMESTIC PORTLAND CEMENT FROM MILLS INTO STATES AND PER CAPITA, 1927 AND 1928, IN BARRELS*

	1927		1928	
State	Total	Per capita*	Total	Per capita*
Alabama	2,264,576	0.89	2,946,905	1.15
Arizona†	562,460	1.23	692,729	1.46
Arkansas†	855,051	.44	1,251,341	.64
California	13,128,911	2.96	12,356,292	2.71
Colorado	1,002,396	.93	1,064,302	.98
Connecticut†	2,061,892	1.26	2,283,726	1.37
Delaware†	342,905	1.41	348,719	1.43
District of Columbia†	981,732	1.82	889,541	1.61
Florida	2,482,725	1.82	1,325,201	.94
Georgia	1,904,685	.60	1,742,266	.54
Idaho†	311,226	.58	294,925	.54
Illinois	14,832,550	2.03	17,676,964	2.39
Indiana	5,738,557	1.82	5,274,423	1.66
Iowa	3,708,471	1.53	5,348,807	2.20
Kansas	2,432,055	1.33	2,341,459	1.28
Kentucky	1,953,629	.77	1,739,053	.68
Louisiana	1,490,560	.77	1,274,387	.65
Maine‡	505,952	.64	522,573	.66
Maryland	2,651,700	1.66	2,242,316	1.39
Massachusetts†	2,820,132	.66	2,915,928	.68
Michigan	11,576,188	2.58	11,775,822	2.56
Minnesota	3,380,002	1.26	3,054,582	1.12
Mississippi†	980,791	.55	1,128,613	.63
Missouri	4,207,151	1.20	4,717,741	1.34
Montana	307,968	.43	461,299	.84
Nebraska	1,360,032	.97	1,195,650	.85
Nevada†	87,276	1.13	106,321	1.37
New Hampshire†	459,706	1.01	515,317	1.13
New Jersey	8,419,323	2.25	8,436,886	2.21
New Mexico†	278,528	.71	333,250	.84
New York	23,002,585	2.01	22,320,713	1.93
North Carolina†	3,213,314	1.11	2,400,601	.82
North Dakota†	392,730	.61	454,873	.71
Ohio	10,342,424	1.54	11,013,338	1.61
Oklahoma	3,119,565	1.31	3,125,602	1.29
Oregon	1,399,167	1.57	1,255,925	1.39
Pennsylvania	13,837,359	1.42	12,996,494	1.32
Rhode Island†	700,851	1.00	760.813	1.06
South Carolina†	985,874	.53	1,508,279	.81
South Dakota	409,820	.59	491.102	.70
Tennessee	2,262,697	.91	2,697,996	1.08
Texas	5,437,907	1.01	6,193,925	1.13
Utah	428.469	.82	507.666	.96
Vermont†	393,294	1.12	605,930	1.72
Virginia	1,799,062	.71	1,993,581	.77
Washington	2,574.293	1.65	2,972,167	1.87
West Virginia	1,561.978	.92	1.360,192	.79
Wisconsin	5,553.176	1.90	5,380,070	1.82
Wyoming†	181,103	.75	197,144	.80
Unspecified	51.818	....	83,869	....
	170,736,616	1.44	174,577,618	1.45
Exports reported by manufacturers but not included above§	1,128,112	—	1,157,356	—
Total shipped from cement plants	171,864,728	—	175,734,974	—

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*Per capita figures based on estimate of population made by the Bureau of the Census.

†Non-cement-producing state.

‡Maine began producing April, shipping May, 1928.

§Includes shipments to Alaska, Hawaii, and Porto Rico.

Iowa Cement Plants Show Larger Output

Production in 1929 will probably exceed that of last year because of the large amount of cement being used in paving Iowa's roads, the sum being expended on highways this year amounting to more than $26,000,000.

Norwegian Imports in 1928 Show Greatest Increase

During the year 1928, six and one-half times more cement was exported from Norway than was imported. The market for foreign cement in Norway, therefore, is very limited, as domestic production supplies by far the greater part of the local requirements, according to the Bureau of Foreign and Domestic Commerce of the Department of Commerce.

Exports which registered 872,749 barrels in 1927 advanced to 940,138 barrels during 1928. Exports to the United States are restricted on account of existing prices and customs regulations, as well as the large competition with the Belgian and Polish factories. The principal consumer of Norwegian cement, in 1928 was South America. Considerable quantities were also shipped to the West Indies, whereas the other markets were of minor importance.

In the following table it will be noted that there was a greater increase in the exports of cement from Norway during 1927 than occurred in any preceding year. In other words, the percentage increase was greater from 1926 to 1927 than took place during the entire period from 1913 to 1926.

Exports of Cement from Norway in Barrels of 376 *Lbs.*

Country	1913	1926	1927
Sweden	2,371	5,080	6,015
Denmark	7,780	158	—
Iceland	1,220	2,175	11,890
Finland	252	246	586
Switzerland	94	—	—
Netherlands	1,349	—	—
West Africa	422	—	—
East Africa	2,504	16,299	33,091
Australia	20,128	—	—
South America	—	81,191	497,423
Central America	—	14,147	57,838
Cuba	—	651	—
United States	135	14,792	250,198
Other Countries	416	35,606	15,707
Total	36,671	170,345	872,748

With the exception of one operation, all the Norwegian cement factories were in operation during the year 1928. The domestic turnover, which was somewhat larger than during the immediately preceding years approximated that of 1923. Although the increase in the domestic consumption is due to some extent to the large building projects in the western part of the country, the main reason for the increase is attributed to the fact that the advantageous use of cement for building purposes is steadily meeting greater understanding.

Imports expanded somewhat during 1928 namely from 94,189 barrels in 1927 to 144,593 barrels in 1928.

Imports of Cement Into Norway in Barrels of 376 *Lbs.*

Country	1913	1926	1927
Sweden	551	70,116	1,149
Denmark	50,967	58,894	786
Germany	133,899	95,414	49,747
Netherlands	6	135	235
Belgium	1,933	42,988	25,456
Great Britain	135	—	11,194
Poland	—	2,468	11,227
France	—	4,978	1,161
United States	—	240	399
Other Countries	—	35	3,829
Total	187,491	275.268	94.183

Studies of Alite

(Continued from Page 104)

TABLE 5

Evaluation of Debye-Scherrer X-rays (copper radiation) of alite fractions of two clinkers and their comparison with tricalcium and bicalcium-silicate

Line	Alite Fraction of Clinker G		Clinker O		Tricalcium-Silicate $3\,CaO \cdot SiO_2$		β-Bicalcium-Silicate $\beta \cdot 2\,CaO \cdot SiO_2$	
	$d = \frac{Cu\,\alpha}{2 \sin \vartheta}$	Relative Line Intensity[1]	$d = \frac{Cu\,\alpha}{2 \sin \vartheta}$	Relative Line Intensity[1]	$d = \frac{Mo\,\alpha}{2 \sin \vartheta}$	Relative Line Intensity[1]	$d = \frac{Mo\,\alpha}{2 \sin \vartheta}$	Relative Line Intensity[1]
1	4.34	m. st.	—	—	—	—	—	—
2	3.88	m. st.	3.83	st.	—	—	—	—
3	3.35	m. s.	3.35	m.	—	—	—	—
4	3.022	s. st.	3.033	s. st.	3.02	s. st.	—	—
5	2.91	s.	2.88	s. s.	—	—	2.88	s.
							2.77	s. st.
6	2.736	s. st.	2.732	s. st.	2.75	s. st.	2.74	m.
							2.60	m.
7	2.601	s. st.	2.594	s. st.	2.59	s. st.	2.54	s.
8	2.427	s.	2.411	s.	2.44	s.	2.44	s.
9	2.312	m.	2.290	m.	2.32	m.	2.39	s.
							2.28	s.
10	2.188	s. st.	2.176	s. st.	2.18	s. st.	2.18	st.
							2.11	s.
11	2.11	s. s.	2.059	s.	2.07	s.	2.08	s.
12	1.94_3[2]	m. verbr.	1.943	m. verbr.	1.973 } 1.949	m.	2.05	s.
					1.925 }	m.	1.975	m.
13	1.81_9	s.	1.82	s.	1.824	m.	1.895	m.
14	1.761	s. st.	1.756	s. st.	1.761	s. st.	1.793	s.
15	1.69_5	s. s.	1.694	s.	—	—	1.695	s.
16	1.64	s.	—	—	—	—	—	—
17	1.623	st.	1.620	st.	1.626	st.	1.620	m.
18	1.535	m.	1.535	m.	1.536	m.	1.568	s.
							1.545	s.
19	1.485	st.	1.481	st.	1.485	st.	1.518	s.
							1.483	s.
20	1.45_7	s.	1.45_2[2]	s.	1.449	s.	1.410	s.
21	1.43_3	s. s.	—	—	—	—	—	—
22	1.39_2	s. s.	1.38_6	s. s.	1.384	m.	1.383	s.
							1.360	s.
23	1.30_2	s. s.	1.30_9	s. s.	1.300	s.	1.286	s.
24	1.26_4	s. s.	1.25_5	ss. verbr.	1.271	s.	1.243	s.
					1.227	s.		
25	1.20_2	m. s.	1.19_4	m. s.	1.193	m.	1.209	s.
26	1.17_5	s. s.	—	—	—	—	1.176	s.
27	1.15_9	m. s.	1.15_7	m. s.	1.158	m.	1.150	s.
28	1.13_4 }	m. s.	1.130	m. s.	1.128	m.	1.132	s.
	} 1.127							
29	1.11_9 }	m. s.	—	—	—	—	—	—
30	1.08_7	m. s.	1.09_0	m. s.	1.091	m.	1.097	s.
31	1.060	s.	1.06_1	s.	1.066	s.	1.073	s.
32	1.04_7	s. s.	1.040	s.	1.042	s.	1.056	s.
33	1.03_1 }	s.	—	—	—	—	1.039	s.
	} 1.023							
34	1.01_5 }	s.	1.01_9	s.	1.022	s.	—	
35	0.99_3	s.	0.98_9	s. s.	0.992	s.	0.983	s.
36	0.97_1	s.	0.96_2	s. s.	0.969	s.	—	
37	0.95_4[3]	s.	0.95_7	s. s.	0.954	s.	0.956	s.
38	0.89_4 }	s. s.	0.88_9	s. s.	0.888	s.	0.906	s.
	} 0.888							
39	0.88_2[4] }	s. s.	—	—	—	—	0.854	s.
40	0.84_1	s. s.	0.84_3	s. s.	0.839	s.		
41	0.81_9	s. s.	0.82_0	s. s.	0.821	s.		
42	0.80_9	s. s.	—	—	—	—		

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[1] Line intensity: s. st.—very strong
st.—strong
m.—medium
s.—weak
s. s.—very weak

[2] Large figures including the third decimal are values of precision measurements; the others were computed from ordinary X-rays, applying the correction obtained from precision measurements.

[3] Also 3 very weak lines with d = 0.93_7; 0.91_9; 0.90_1.

[4] Also another, very weak line with d = 0.85_7.

present investigation did not show the characteristic, most intensive lines of the free lime with d = 2.40 and d = 1700.

A special X-ray made in the Kaiser-Wilhelm Institute of celite isolated by the authors, showed lines, which, regarding the quantity of celite present and the intensity of lines to be expected, could not be adjusted to those of the alite diagram. The marked line d = 3.88 could at most have been produced by celite, for it occurs in its diagram; yet, considering the slight amount of celite in the alite fractions, it is too intense. Thus X-rays do not unquestionably prove its presence. The minimum quantity for the detection of its presence seems to be over 5 per cent (see Table 3). The same applies to lines of tricalcium-aluminate, numerically determined as 1.9 to 5.5 per cent in the alite fractions and which appears to be present as free tricalcium-aluminate according to the color tests, as bicalcium-silicate is not stable as such.

Neither did the X-rays indicate that considerable quantities of alumina entered in the structure of alite. The zone formation found by the authors in previous tests and described at an earlier date[21] remains as yet without an explanation. It is possible that certain secondary constituents of alite, such as magnesia, may produce this phenomenon under certain conditions of heat application and cooling.

The conception of alite advanced by Jänecke must be refuted by the authors; for, if, according to him, alite is neither bicalcium-silicate nor Jäneckeit nor yet a mixed crystal of the latter with dicalcium-silicate, the ratio of lime to silica and alumina in alite would have to be kept within the limits:

$$\frac{2\,\mathrm{CaO}}{1\,\mathrm{SiO_2}} = \frac{2}{1};\quad \frac{8\,\mathrm{CaO}}{1\,\mathrm{Al_2O_3}\,.\,2\,\mathrm{SiO_2}} = \frac{2.67}{1}$$

Therefore, Jänecke's alite can have at most a ratio of lime to silica and alumina of $\frac{2.67}{1}$, and may have free lime present. As the authors' Clinker O was shown to contain no free lime, yet had the ratio of 2.99, while the other clinker with a ratio of 3.11 was proven analytically as well as with the aid of X-rays to contain not more than 3 per cent of free lime, Jänecke's assumption is definitely disproved thereby.

Finally it may be added that the small quantities of magnesia, sodium and titanium found by analytical means, apparently exist without disturbing the structure of the alite crystal. The same phenomenon was found to be true of most rock minerals.

Practical Conclusions

The practical conclusions, which may be derived from the foregoing evidence concerning the composition of high test cements, especially with regard to lime content, have already been expounded in the authors' publication on celite. The latter gives two formulas in accordance with the relation of alumina to iron oxide—which permit one to compute, whether the lime limit of a portland cement has been reached or exceeded:

1. When the percentage of $\mathrm{Al_2O_3} \geqq 0.64$ ($\mathrm{Fe_2O_3} + \mathrm{Mn_2O_3}$) per cent, the formula used is:

$$\frac{1.07\,\mathrm{CaO} - (0.38/\mathrm{Fe_2O_3}+\mathrm{Mn_2O_3}/+1.76\,\mathrm{Al_2O_3}+0.75\mathrm{SO_3})}{\mathrm{SiO_2}} \leqq 3$$

2. When the percentage of $\mathrm{Al_2O_3} < 0.64$ ($\mathrm{Fe_2O_3} + \mathrm{Mn_2O_3}$) per cent, the formula is:

$$\frac{1.07\,\mathrm{CaO} - (1.17\mathrm{Al_2O_3}+0.75/\mathrm{Fe_2O_3}+\mathrm{Mn_2O_3}+\mathrm{SO_3}/)}{\mathrm{SiO_2}} \leqq 3$$

Kühl finds[22]—in leaving out the SO_3 content—that the second formula agrees with his own, in which *x* designates the quantity of limestone to be used per unit of clay or slag to obtain an ideal portland cement:

$$x = \frac{2.8\,\mathrm{SiO_2}+1.1\,\mathrm{Al_2O_3}+0.7\,\mathrm{Fe_2O_3}-\mathrm{CaO}\ \ \text{Per cent in (clay or slag)}}{2.8\,\mathrm{SiO_2}+1.1\,\mathrm{Al_2O_3}+0.7\,\mathrm{Fe_2O_3}-\mathrm{CaO}\ \ \text{(limestone)}}$$

In this formula one may introduce for Fe_2O_3 the sum of iron and manganese oxides. With the exception of the magnesia content, this formula is identical with that by Newberry:[23] 2.8 per cent SiO_2 + 1.1 per cent Al_2O_3 + 0.7 per cent Fe_2O_3 = CaO + 1.4 MgO.

The importance accorded by Newberry to magnesia may not be entirely justified, yet the generality of Kühl's formula may also be doubted, as cements whose alumina exceeds the iron oxide, as it is ordinarily present, may have a higher lime content, for then alumina not contained in celite may crystallize as tricalcium-aluminate. The authors' formula 2, as well as Kühl's formula, deal with special cases of Erzzement (iron cement), Kühl's cement, etc., while the standard portland mix should be proportioned in accordance with the authors' formula 1, the quantity of limestone *x* per unit of clay or slag being:

$$x = \frac{2.8\,\mathrm{SiO_2}+1.65\mathrm{Al_2O_3}+0.35\,\mathrm{Fe_2O_3}-\mathrm{CaO}\ \text{Per cent in (clay or slag)}}{2.8\,\mathrm{SiO_2}+1.65\mathrm{Al_2O_3}+0.35\,\mathrm{Fe_2O_3}-\mathrm{CaO}\ \ \text{(limestone)}}$$

Up to the time when the lime limit is definitely determined in the sintering diagram of CaO, SiO_2, Al_2O_3, Fe_2O_3, this expression will give good service as an approximation. The position of magnesia in the clinker is also to be cleared.

Summary

The study of two portland cement clinkers of different composition yielded upon isolation of their main constituent: (1) that it was identical with the crystalline formation of alite; (2) that its chemical composition and its structure were almost identical with those of pure tricalcium-silicate.

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[21] *Zement*, 1928, No. 8, p. 296.

[22] "Computation of the Best Raw Mix," *Zement*, 1929, No. 27.

[23] CEMENT AGE, July, 1905, p. 75.

Association Makes Final Report on June Safety Campaign

Final figures for the accident prevention campaign conducted by the Portland Cement Association during June show that there were 40 mishaps reported during the month for the 159 plants reporting.

Lost-time accidents were cut 24.3 per cent during the first half of the year, a reduction of 24.3 over the same period of 1928 and 73 per cent over those for 1925.

Penn-Dixie Making Drilling Tests in Iowa

The Pennsylvania-Dixie Cement Corporation, which a year ago took over the Pyramid Cement Company plant at Valley Junction, Iowa, is now making drilling tests on 500 acres of land near Earlham, Iowa. Options on three farms have been secured.

MEN and MILLS

Notes from the Field

Howard H. Leh Resigns from Lone Star to Become New Manager for Keystone

Howard H. Leh on August 1st assumed the general managership of the Keystone Portland Cement Company plant at Bath. He was superintendent for the past year of the Lone Star Portland Cement plant at Nazareth and prior to that time had served in a similar capacity when the same plant was operated by the Phoenix Portland Cement Company.

Mr. Leh was superintendent of the Phoenix Cement Company for ten years prior to its purchase by the International Cement Corporation a year ago and continued in that capacity when the plant was renamed "Lone Star." Mr. Leh tendered his resignation several weeks ago and was about to accept a position at Buffalo, when he was offered and accepted the general managership of the Keystone plant.

Before leaving the Lone Star plant, Mr. Leh was called into the machine shops by all the employes and was presented a handsome watch and other useful and appropriate articles as a remembrance of the high esteem the workmen had for him.

Mr. Leh is a director of the Limestone Products Company of America, which operates a plant at Newton, N. J. He has been interested during the past ten years in the design and construction of several cement plants in the South.

Pierson Assumes Vice President's Role with Indiana Lone Star

G. E. Pierson, manager and sales manager of the Lone Star Cement Company, Indiana, Inc., has been elected vice-president of that company. He will continue as manager, but is relieved of his duties as sales manager.

Mr. Pierson went to Indianapolis from Kansas City, Mo., three years ago as sales manager. His appointment as manager was made last year. He succeeds D. S. MacBride as vice-president.

Elected Monolith Vice President

R. I. Vance of the Denver office of the Monolith Portland Midwest Company was elected vice-president of the company at the meeting of directors held July 30th.

Col. MacNider Estate Exceeds Two Million, Tax Report Shows

The estate of the late C. H. MacNider, former president and general manager of the Northwestern States Portland Cement Company at Mason City, Iowa, is estimated at $2,447,037, according to a preliminary tax report.

Manitowoc Entertains City Officials and Business Men

City officials and business men of Manitowoc, Wisconsin, were the guests of the Manitowoc Portland Cement Company at that city on Tuesday, July 30th.

Taylor New Traffic Manager for Republic Cement Co. at San Antonio

T. C. Taylor has resigned the position of assistant traffic manager of the International Cement Corporation in New York to assume the traffic managership of the Republic Portland Cement Company at San Antonio.

SAFETY COMMITTEE OF PRIZE-WINNING PLANT

The 1928 *Safety Committee of the Alpha Portland Cement Co. plant at Manheim, W. Va., which was one of those recently awarded the Portland Cement Association trophy. First row seated, left to right: C. H. Bolyard, W. B. Shaver, L. M. Smith, W. L. Matthes, Dr. M. H. Proudfoot, D. A. McVicker. First row standing, left to right: R. H. Fretwell, H. H. Davis, A. H. Fretwell, J. P. Layton, Bailey McVicker, Charles Grimm, E. H. Bolyard, C. B. Bishoff, N. D. Hooton, Phillip Brutto. Second row standing, left to right: Gilbert Goof, F. S. Fretwell, O. R. Deweitt, F. W. Gibson, Noah Witt, W. S. Heath, H. E. Lenker, J. T. Sinott, R. M. Hertzog*

Cement Statistics for July

July Production Lower—Shipments and Stocks Slightly Higher—Total of Plants Now 163

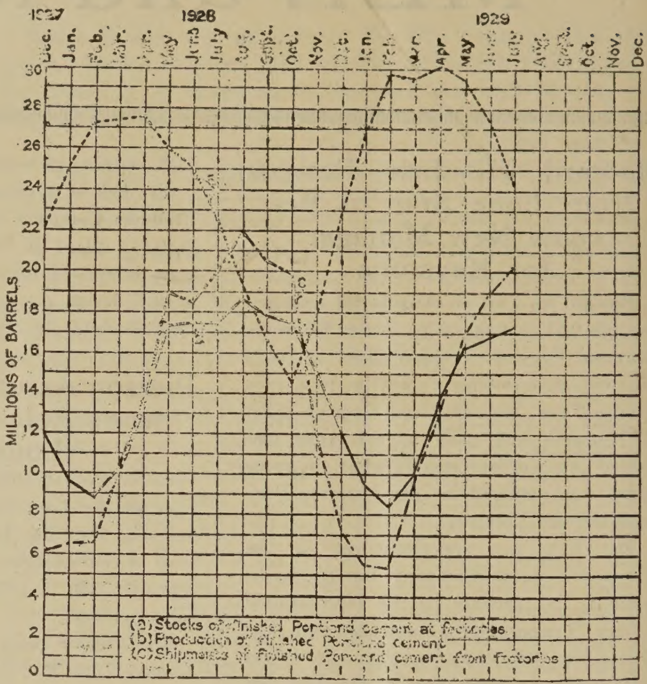
NOTE: IN ORDER THAT THE READER MAY KNOW THE TREND AT A GLANCE, THE HIGHER FIGURE, WHETHER FOR EITHER YEAR, UNDER ANY CLASSIFICATION, APPEARS IN SLIGHTLY HEAVIER TYPE.

Relation of Production to Capacity

(Figures represent per cent)

	—July—		June	May	April
	1928	1929	1929	1929	1929
The month	**87.0**	80.4	80.9	76.4	67.1
The 12 months ended	**73.7**	68.9	69.0	70.2	71.1

	1928	1929	Increase or Decrease, Per Cent
Production, July	17,474,000	17,216,000	—1.5
Shipments, July	19,901,000	20,273,000	1.9
Stocks at end of July	22,580,000	24,372,000	7.9
Total production for year to date	94,535,0000	92,264,000	2.5
Total shipments for year to date	93,854,000	90,514,000	3.7
No. of plants reporting	158	163	



Production, Shipments and Stocks of Finished Portland Cement, by Districts, in July, 1928 and 1929, and Stocks in June, 1929

District	Production—July 1928	Production—July 1929	Shipments—July 1928	Shipments—July 1929	Stocks at end of month 1928	Stocks at end of month 1929	Stocks at end of June, 1929*
Eastern Pa., N. J., and Md.	**3,832,000**	3,709,000	4,042,000	**4,171,000**	**5,913,000**	5,389,000	5,852,000
New York and Maine	1,207,000	**1,366,000**	1,428,000	**1,609,000**	1,622,000	1,766,000	2,009,000
Ohio, Western Pa., and W. Va.	1,843,000	**2,075,000**	2,172,000	**2,246,000**	3,096,000	**3,378,000**	3,550,000
Michigan	**1,662,000**	1,432,000	1,872,000	**1,964,000**	1,748,000	**1,937,000**	2,469,000
Wisconsin, Illinois, Indiana, and Ky.	**2,375,000**	2,354,000	**2,863,000**	2,837,000	2,506,000	**3,168,000**	3,650,000
Va., Tenn., Ala., Ga., Fla., and La.	**1,414,000**	1,216,000	1,419,000	**1,520,000**	**1,867,000**	1,759,000	2,063,000
Eastern Mo., Iowa, Minn., and S. Dak.	**1,736,000**	1,569,000	**2,323,000**	2,223,000	2,544,000	**3,092,000**	3,745,000
Western Mo., Nebr., Kans., and Okla.	1,027,000	**1,159,000**	1,227,000	**1,382,000**	**1,370,000**	1,269,000	1,492,000
Texas	561,000	**701,000**	603,000	**666,000**	314,000	**546,000**	510,000
Colo., Mont., Utah, Wyo. and Idaho	260,000	**322,000**	291,000	**299,000**	456,000	**529,000**	506,000
California	**1,124,000**	991,000	**1,192,000**	994,000	752,000	**991,000**	995,000
Oregon and Washington	**433,000**	322,000	**469,000**	362,000	392,000	**548,000**	587,000
	17,474,000	17,216,000	19,901,000	**20,273,000**	22,580,000	**24,372,000**	27,428,000

Production, Shipments and Stocks of Finished Portland Cement, by Months, in 1928 and 1929

Month	1928—Production	1929	1928—Shipments	1929	Stocks at end of month 1928	Stocks at end of month 1929
January	9,768,000	**9,881,000**	**6,541,000**	5,707,000	25,116,000	**26,797,000**
February	**8,797,000**	8,522,000	**6,563,000**	5,448,000	27,349,000	**29,870,000**
March	**10,223,000**	9,969,000	**10,135,000**	10,113,000	27,445,000	**29,724,000**
April	13,468,000	**13,750,000**	13,307,000	**13,325,000**	27,627,000	**30,151,000**
May	**17,308,000**	16,151,000	**18,986,000**	16,706,000	25,984,000	**29,597,000**
June	**17,497,000**	16,775,000	18,421,000	***18,942,000**	25,029,000	***27,428,000**
July	**17,474,000**	17,216,000	19,901,000	**20,273,000**	22,580,000	**24,372,000**
August	18,759,000		21,970,000		19,374,000	
September	17,884,000		20,460,000		16,799,000	
October	17,533,000		19,836,000		14,579,000	
November	15,068,000		11,951,000		17,769,000	
December	12,189,000		7,384,000		22,650,000	
	175,968,000		175,455,000			

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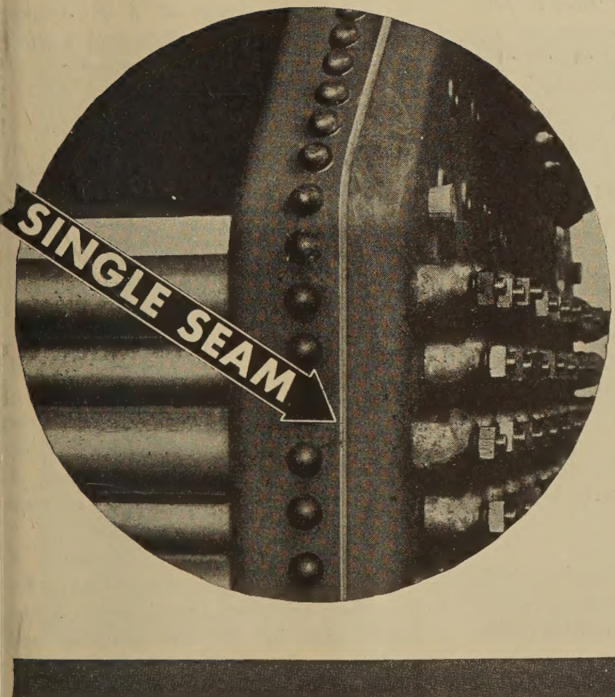
*Revised.

†The inclusion of Wyoming begins with April, 1929; of Idaho with June, 1929.

A NEW DESIGN

BOX-HEADER BOILER



The new C-E Single-Seam Box-Header Boiler is a distinct advance in construction and design over ordinary box header practice.

In the new design —

The wrapper or butt strap joining the tube and hand hole sheets is — ELIMINATED.

ONE ROW OF RIVETS JOINS THE TUBE SHEET DIRECTLY TO THE HAND HOLE SHEET.

The row of rivets on the tube side of the wrapper strap is — ELIMINATED.

THERE IS ONLY ONE CAULKING EDGE and this faces the outside — making inspection easy and removing all rivets out of the hot gas and fire zones.

Three thicknesses of metal at the caulking joint at the ears are — REDUCED TO TWO THICKNESSES.

This new design provides an unusual factor of safety. For instance, in the standard unit sold for 160 lb. to 250 lb. working pressure, the header joint is adequate for a working pressure of 450 lb.

A careful inspection of this new boiler will convince you that the C-E Box-Header Boiler is a better Box-Header Boiler.

COMBUSTION ENGINEERING CORPORATION

International Combustion Building
200 Madison Avenue, New York

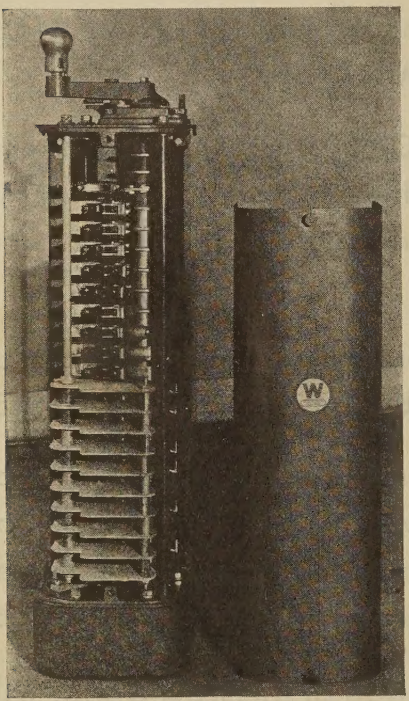
A Subsidiary of
International Combustion Engineering Corporation

Mill Equipment

New Westinghouse Reversing Drum Controller

A new line of reversing drum controllers is announced by the Westinghouse Electric & Manufacturing Company. These controllers to be known as Type A controllers, are listed in classes 8300 and 8400 for D. C. service, and in classes 12-700 and 12-800 for A. C. service. They are designed for heavy usage in operating cranes, hoists, bending rolls, railway turntables and the like. They incorporate many new features and refinements in design and operation which set a new standard of utility.

The drum cylinder consists of rolled brass supporting discs assembled on a micarta insulated steel shaft between brass and micarta insulating collars. The contact segments are bolted to the supporting discs in such a way as to entirely eliminate burning of the bolt heads. The segments are reversible. Burned ends may be trimmed down to form shorter segments, thus reducing the stock of renewal parts necessary.



The fingers are of the compensating, self-aligning type which assure square alignment on the contact segments. An adjustment is provided to compensate for finger wear while localized heating of the joints is prevented by copper shunts direct from the terminals to the finger tips.

New Magnetic Switch Has Oil-Immersed Contacts

The General Electric Company, Schenectady, N. Y., announces a new oil-immersed magnetic switch of small capacity. This device is particularly suitable for use in gaseous atmospheres or in locations where highly corrosive gases or acids are encountered. It bears the designation CR-7006-V-7.

The new switch has a capacity of 40 amperes and can be used with any motor, from 110 to 600 volts, the full-load current of which does not exceed this value. The contactor and interlock are standard in design. The overload relay used has oil-immersed contact tips in which the heaters are located above the oil level. The relay is reset from the top of the oil tank.

The enclosing tank is ¼-inch sheet metal with a flange for wall mounting. The tank is provided with a felt gasket to prevent the entry of dust.

NOTES FROM THE FIELD

Darius E. Peck, G. E. Vice-President

Darius E. Peck, assistant manager of the law department of the *General Electric Company* since 1920, was elected vice-president and general counsel of the company at a meeting of the board of directors in New York on August 1st. At the same time President Gerald Swope announced the retirement of *Allen H. Jackson,* who has been vice-president and general counsel since 1922 and associated in the company's law department since 1902.

D. E. Peck was elected vice-president and general counsel of the company, effective August 1, 1929.

The meeting of the board of directors was held aboard the electric yacht of George F. Baker, Jr., a member of the board.

Combustion Makes Changes

Combustion Engineering Corporation announces the following changes in its southern district offices.

The territory previously known as the Atlanta district, has been divided into three sections, served by offices located in Charlotte, N. C., Atlanta, Ga., and New Orleans, La.

T. W. Battle has been appointed district manager of the Charlotte territory, with offices at 919 Johnston Bldg., Charlotte, N. C.

I. S. Forde has been appointed acting district manager of the Atlanta territory, to succeed T. J. Cleary, resigned, with offices at Candler Bldg., Atlanta, Ga.

E. C. Wathall has been appointed district manager of the New Orleans territory, with offices at 1118 Union Indemnity Bldg., New Orleans, La.

The above changes were effective as of July 1.

The district offices at Memphis, Tenn., and Houston, Texas, will continue to serve the same territories as in the past. *C. R. Herron* is manager of the Memphis territory with offices at 816 Dermon Bldg., Memphis, Tenn. *J. W. Mason* is manager of the Houston Territory with offices at 818 Niels Esperson Bldg., Houston, Texas.

Webb W. A. Jones Representative

The appointment of *Warren C. Webb* as Pacific Coast sales manager, with offices at Los Angeles, California, has been announced by the *W. A. Jones Foundry and Machine Company* of Chicago, Illinois.

New Union Chain Appointments

Users of power transmission, elevating and conveying chain in the territories affected will be interested in the recent announcement of the opening of two new sales offices by the *Union Chain & Mfg. Co.* of Sandusky, Ohio.

Hugh Scott, experienced in power transmission, elevating and conveying, has opened the St. Louis office at Third and Plum Streets in the Missouri metropolis.

The Indianapolis office at 1535 Naomi St. will be in charge of *A. R. Young,* formerly of the home office, and a practical power transmission engineer.

Elverite Chilled Iron

According to recent announcements, all chilled iron products of the *Fuller-Lehigh Company,* Fullerton, Pa., in the future will be known as *Elverite.*

This is in tribute to *J. S. Elverson,* who for more than twenty-five years has specialized in the Fuller-Lehigh chilled-casting work.

Sutton Pittsburgh Manager

Announcement has been made by the *W. A. Jones Foundry and Machine Company,* Chicago, of the appointment of *Walter M. Sutton* as manager of their Pittsburgh office.

Mr. Sutton formerly was in charge of the St. Louis office for the company. Before that he spent several years in the home office in the manufacturing and engineering departments.